U.S. Army Corps of Engineers
Jacksonville District

FINAL ENVIRONMENTAL IMPACT STATEMENT

Interim Operational Plan (IOP)
for Protection of the Cape Sable Seaside Sparrow

Abstract: This Final Environmental Impact Statement (FEIS) presents a final recommended plan, Alternative 7R, that improves upon the preliminarily recommended plan, Alternative 7, in the Supplemental Draft EIS issued in October 2001. An improvement was made to Alternative 7 to create favorable hydroperiods in sparrow habitat in Everglades National Park (Park) while providing flood protection capability for developed lands east of the L-31N Canal. Alternative 7R includes operation of previously authorized structural features described in the 1992 Modified Water Deliveries to Everglades National Park report and the 1994 and 2001 C-111 reports that will maintain flood protection capability, while continuing to provide full protection for the Cape Sable seaside sparrow and its habitat. The increased capability over Alternative 7 is obtained by adding an additional pump station (S-332C) and seepage reservoirs along the L-31N Canal to supplement the capacity of the existing pump station, S-332B, to lower canal and groundwater levels in advance of significant storms. Construction of the previously authorized pump station S-356 in the Tamiami Canal is also included so that it can be used to return to Northeast Shark River Slough the seepage from the northern reach of the L-31N Canal, thereby lowering canal stages in advance of storms. These pump stations are being built as interim structures to enable their completion, along with associated seepage reservoirs, by June 2002 for use in protecting sparrow habitat during the upcoming wet season. Alternative 7R incorporates the system operations of Alternative 7, including a second seepage reservoir for Pump Station S-332B and the removal of the southern four miles of Levee 67 Extension and canal. This FEIS describes and evaluates Alternative 7R in comparison with the alternatives previously addressed in the Supplemental DEIS. All information in the Supplemental DEIS is incorporated herein by reference.

Send Your Comments to the
District Engineer by June 3, 2002

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EXECUTIVE SUMMARY

Background. On February 19, 1999, the FWS issued a Final Biological Opinion (B.O.) under provisions of the Endangered Species Act of 1973, as amended, for actions required to assure the survival of the endangered Cape Sable Seaside Sparrow, related to operation of components of the Central and Southern Florida (C&SF) Project in Miami-Dade County. The B.O. referenced specifically rapid implementation of structural and operational changes under the Modified Water Deliveries (MWD) Project, to existing operations under Test 7 of the Experimental Program of Water Deliveries, and to the C-111 Canal Project. The B.O. concluded that continuation of Test 7, Phase I operations would cause adverse modification of Cape Sable Seaside Sparrow (CSSS) critical habitat and would jeopardize the continued existence of the CSSS. The B.O. presented Reasonable and Prudent Alternatives to the then existing operations that would avoid jeopardizing the CSSS. The RPA recommended that the following hydrological conditions be met for protection of the CSSS: 1) A minimum of 60 consecutive days of water levels at or below 6.0 feet NGVD at the NP 205 gauge between March 1 and July 15; 2) Ensure that 30%, 45%, and 60% of required regulatory releases crossing Tamiami Trail enter ENP east of L-67 extension in 2000, 2001, and 2002, respectively, or produce hydroperiods and water levels in the vicinity of subpopulations C, E, and F that meet or exceed those produced by the 30% , 45% , and 60% targets; and 3) Produce hydroperiods and water levels in the vicinity of subpopulations C, E, and F that equal or exceed conditions that would be produced by implementing the exact provisions of Test 7, Phase II operations (USACE 1995); and implement the entire MWD project no later than December, 2003.

Emergency deviations from Test 7 were authorized in 1998, 1999, 2000, and 2001 by CEQ to allow the Corps to conduct water control operations to protect the CSSS (USACE 1999b; USACE 1999c; USACE 2000). These Interim Operational and Structural Plans (ISOP) enabled the Corps to maintain water levels, particularly in the western CSSS populations, that would maximize breeding seasons for the sparrow.

During implementation of the ISOP, the U.S. Army Corps of Engineers (Corps) received confirmation from the FWS that producing the hydrologic equivalent of the 30, 45, and 60% conditions, as opposed to the actual release percentages, would also meet the FWS RPA conditions until the implementation of MWD. The proposed actions under this Interim Operational Plan (IOP) would allow the Corps to meet or provide the hydrologic equivalent of the FWS RPA conditions, while managing the system for purposes authorized under the C&SF Project.

Alternatives. Representatives from the various agencies evaluated a number of options that had potential as solutions in satisfying the project purpose by using 95 Base conditions and the ISOP operations as a base. These options included changes in operational criteria for existing structures throughout the region that could influence water levels within the various CSSS subpopulations. Two interagency modeling meetings were held to discuss potential options for meeting the criteria stated in the FWS B.O. and to evaluate modeling runs produced by the Corps prior to the meetings. Changes in the operation of various structures were proposed during the meetings and in subsequent correspondence, and appropriate model

runs were produced. The modeling runs were posted on the Jacksonville District, Corps of Engineers Website as each was produced. The interagency review team members were informed as the model runs were posted, and comments and suggestions were used to modify the potential alternative plans. The alternative models were compared to the 1995 Base conditions, which represent conditions under normal C&SF operations with Test 7, Phase I operations in the ENP/South Dade Conveyance System (SDCS) prior to emergency deviations.

Six alternative plans were developed and analyzed in the February 2001 Draft EIS. Since that time, the Council on Environmental Quality (CEQ), Institute for Environmental Conflict Resolution (IECR) facilitated a collaborative interagency team from the Corps, FWS, SFWMD, and ENP to formulate a consensus alternative that met the criteria in the B.O. while providing for maximum protection of the resource concerns of the interested parties. The plan proposed during this process, Alternative 7, consists of two different modes of water management operation for SDCS and a structural modification of the L-67 extension levee. The first mode is “No WCA 3A regulatory releases to SDCS” operation in which L-31N canal would be maintained at Test 7 Phase I level when there are no WCA 3A regulatory releases. Citing a concern that maintaining L-31N canal at ISOP level would impact Everglades National Park resources in NESRS, a "No WCA 3A regulatory releases to SDCS" operation was proposed that essentially reverts back to Test 7 Phase I canal level when no regulatory releases are routed through S-333 and S-334 to SDCS. The Corps along with SFWMD agreed to incorporate this operation as part of Alternative 7.

The second mode of operations is "WCA 3A regulatory releases to SDCS" operation in which L-31N canal would be lowered to minimize potential flood impacts in SDCS and at the same time, provide necessary downstream gradient to move WCA 3A regulatory releases through S-333 and S-334. The purpose of routing of regulatory releases from WCA 3A to SDCS with lower canal stage in L-31N is to provide sufficient water to be delivered via S-332B to the habitats of sparrow sub-populations E and F and at the same time, minimize potential flooding impacts to 8.5 SMA and agricultural areas adjacent to L-31N canal.

Alternative 7 includes an additional 240 acre retention basin at the S-332B structure, increasing capacity from 160 acres of retention to 400 acres, and operations of this area, intended to re-hydrate adjacent CSSS habitat inside the Park, would be modified to avoid pumping to overflow except under unusual and uncommon circumstances.

Modifications to Alternative 7 were developed in response to comments submitted by the public and cooperators during the NEPA comment period. The Stakeholders including the SFWMD and agricultural interests commented that the existing capability for flood control in the agricultural and residential areas potentially affected by the project might be adversely affected and must be maintained. With the existing water management infrastructure, the higher L-31N Canal stages that would occur under Alternative 7 might not, under certain meteorological conditions, allow for sufficient draw-down of groundwater levels in advance of significant impending storms to meet this criterion. Consequently, Alternative 7 would potentially result in an increased risk of flooding over the present conditions.

To address this concern, Alternative 7 was adjusted and is now described as Alt.7R. It would provide increased capability to draw down groundwater levels when a significant storm is predicted, while retaining all of the sparrow protection features of Alternative 7. The increased capability is obtained by adding an additional pump station (S-332C) and seepage reservoirs along the L-31N Canal to supplement the capacity of S-332B to lower canal and groundwater levels. The pump stations draw water out of the canal, thus lowering adjacent groundwater levels. The water is pumped into reservoirs along the eastern boundary of the Park. Some of the pumped water would return to the canal, but there is expected to be a net gain in lowering canal stages. During non-storm conditions, the pump stations would be operated at reduced capacity to maintain a water depth in the reservoirs necessary to create a continuous hydraulic ridge along the Park boundary for seepage control. This hydraulic ridge concept was developed in the authorized C-111 project. The pumping would be adjusted seasonally to maintain the desired water conditions in sparrow habitat within the Park conducive to breeding and habitat maintenance. In conjunction with these features along L-31N, the authorized S-356 pump station is being constructed in the Tamiami Canal where it can be used to collect seepage from ENP along the reach of the L-31N canal which extends from S-335 to G-211 by pumping water west behind the existing S-334 structure and thence into NESRS when conditions permit. Table ES-1 displays the operating parameters for Alternative 7R.

All of these structural elements, which are presently under construction, are authorized features of the MWD and C-111 projects, and have been addressed in previous NEPA documents associated with those projects. As such, they are not proposed features of Alternative 7R. Their construction has been scheduled in conjunction with evaluation of Alternative 7R, and their operation is being addressed in this EIS. To have their construction completed and to be ready for operation under IOP by the time a Record of Decision would be signed for this EIS, these components are being constructed as interim structures. Pump capacity and systems operations will be assessed under the Combined Structural and Operational Plan (CSOP) now under development and expected to be implemented in several years.

Environmental Consequences of the Recommended Alternative. The recommended alternative (Alternative 7R) would affect hydrology of Northeast Shark River Slough (NESRS), western SRS, and WCA 3A and 3B. The hydrology of WCA 2A and 2B would be affected, but only to the same degree as under the No Action Alternative. Hydrological effects (better CSSS breeding conditions) would be beneficial in NESRS and WSRS as recommended in the FWS B.O. Minor adverse effects due to raised water levels could occur in the vicinity of tree islands in the southern portions of WCA 3A and 3B, but water levels of comparable height and duration have been shown to have negligible impacts on tree island vegetation. The recommended alternative would benefit Taylor Slough hydrology.

Impacts to vegetation under the recommended alternative would be similar to those of the No Action Alternative. Increased ponding depths and hydroperiod in NESRS would provide the desired consequence of approaching natural hydrologic conditions more closely, excluding exotic nuisance species and encouraging natural wetland species. A reduction in annual flooding duration in WSRS would also be beneficial to native vegetative species. Increased flood duration could lead to loss of some wetland vegetation in WCA 2A and 3A as well as

upland vegetation (including tree islands) in the southern portion of the areas. Construction of the S-332B seepage reservoir would impact Florida panther habitat, but the nature of the impact and the quality of the habitat are both minimal.

Under the recommended alternative no overflows would occur at the S-332B structure once constructed. Therefore, no introduction of waters containing undesirable nutrient levels into the Park would occur. Construction of the additional C-111 and MWD seepage reservoirs, and their operation under the modified operational plan in conjunction with the existing seepage reservoir, would greatly reduce the potential for overflow in the region.

Areas of Controversy and Unresolved Issues.

Few issues remain unresolved with various commenting agencies and other non-governmental groups regarding the proposed project. Potential impacts to tree islands have been minimized to the greatest practicable extent, as have potential water quality impacts due to releases entering the Everglades National Park. Flooding impacts to residential and agricultural lands above current levels would not likely occur with the recommended alternative.

Some of the conclusions presented in this document are based on certain assumptions by the water managers and best professional judgement of the scientists and engineers involved in the plan formulation process. Many of the uncertainties were previously addressed in the 1999 Restudy Document (Appendix O). The four key uncertainties identified in the uncertainty analysis in the Restudy were 1) Uncertainties about the models; 2) Uncertainties about the linkage between hydrologic change and changes in the ecosystem; 3) Uncertainties about new technologies; and, 4) Uncertainties about the risks associated with the recommended plan.

Comments were received from a number of stakeholders regarding the use of the South Florida Water Management Model (SFWMM) for the hydrologic analysis, which uses two-mile square grids. This model does not allow for a detailed assessment of small, localized areas that may be affected by the project. However, no better model was available for use during the time frame of this project. The Corps is working with the other agencies to implement models that are capable of the resolution appropriate for site-specific analysis.

Incomplete and undefined operations that could have effects in the project area make it difficult to fully evaluate impacts. One example of this is that the operating parameters of the S-356 pump station (authorized with the MWD project) have not yet been determined. A technical team is currently evaluating pumping limits and operations.

Frequency of Pre-storm\Storm\Storm Recovery Operations is unknown. Implementation of these operations would depend on a number of conditions that could only be determined on a case-by-case basis. The antecedent conditions that could affect implementing these operations include pending rainfall events, groundwater table elevation, and canal elevations at the time of the pending rainfall event. The decision making process for determining implementation of the operations is included in Appendix A of this document.

Water managers from the Corps and the SFWMD currently coordinate operations on a daily basis and, if necessary, more often. In addition, the Corps coordinates with other parties that may be affected by operational decisions on an as needed basis. The water managers use actual real-time hydrologic data and weather forecasts to determine appropriate operations.

The Jacksonville District uses the Corps wide standard software and database structure for real-time water control developed by the Hydrologic Engineering Center (HEC) in Davis, California. Time series hydrometeorologic data is stored, retrieved, and displayed using HEC Data Storage System (DSS) databases and programs.

The Jacksonville District receives data from data collection platforms (DCP's). DCP's are devices installed at remote gaging stations which measure real-time data including water surface and groundwater elevations, stream stages, reservoir elevations, cumulative precipitation, wind speed and direction and barometric pressure. Data are transmitted from the DCP via Geostationary Operational Environmental Satellite (GOES) to an earth downlink receiver operated by NOAA/NESDIS in Wallops Island, Virginia.

Automated timed processes also provide provisional near real-time data needed for operations. Additional data is received through an interagency data exchange program between South Florida Water Management District (SFWMD), St. Johns River Water Management District (SJRWMD), Southwest Florida Water Management District (SWFWMD) and Everglades National Park (ENP).

A direct link to the National Weather Service, Southeast River Forecast Center is maintained to provide real-time text and graphics products generated by National Weather Service offices. Information includes weather and flood forecasts and warnings, tropical storm information, NEXRAD radar rainfall, graphical weather maps and more. Selected products are disseminated to area offices in Clewiston, Florida and San Juan, Puerto Rico and posted to internet homepages. Satellite images are also important in making and implementing water management decisions.

A World Wide Web homepage is setup to disseminate information and can be accessed at http://www.saj.usace.army.mil/h2o/.

The Corps would continue to conduct hydrologic modeling and, after consultation with the FWS, ENP, and SFWMD, modify operational parameters if required until the full C-111 and Modified Water Deliveries projects are implemented. In addition, monitoring of vegetative communities, water quality, and fish and wildlife communities is ongoing, and any new data will be used to improve upon the water management operations.

This Interim Operational Plan would be superseded when all elements of the MWD Project are built and capable of operating and when the ROD for CSOP is signed. Currently the MWD project elements are scheduled to be constructed by the end of 2003, and the CSOP plan is scheduled for authorization in 2005.

Table ES-1. Alternative 7R Operations.

	No WCA-3A Regulatory Releases to SDCS or Shark Slough	WCA-3A Regulatory Releases to SDCS
Regulation Schedule	Deviation schedule for WCA-3A, November 2000 WCA-3A interim regulation schedule) as specified by USACE including raising Zone D to Zone C from Nov 1 to Feb 11. No deviation in WCA-2A regulation schedule.	Deviation schedule for WCA-3A, November 2000 WCA-3A interim regulation schedule) as specified by USACE including raising Zone D to Zone C from Nov 1 to Feb 11. No deviation in WCA-2A regulation schedule.
S-343 A/B and S-344	Closed Nov 1 to July 15 independent of WCA-3A levels.	Closed Nov 1 to July 15 independent of WCA-3A levels.
S-12 A/B/C/D Sandbag culverts under Tram Road by 1 February if necessary.	S-12A closed Nov 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12C closed Feb 1 to Jul 15; S-12D no closure dates. Follow WCA 3A regulation schedule after Jul 15. Note: If closure requires regulatory releases to SDCS then switch to operations for regulatory releases to SDCS.	S-12A closed Nov 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12C closed Feb 1 to Jul 15; S-12D no closure dates. Follow WCA 3A regulation schedule after Jul 15.
S-333: G-3273 < 6.8' NGVD Degrade the lower four miles of the L-67 extension	55% of the rainfall plan target to NESRS and 45% through the S-12 structures When WCA-3A is in Zone E1 or above, maximum practicable through S-333 to NESRS per WCA-3A deviation schedule.	55% of the rainfall plan target to NESRS, plus as much of the remaining 45% that the S-12s can't discharge to be passed through S-334; and subject to capacity constraints, which are 1350 cfs at S-333, L-29 maximum stage limit, and canal stage limits downstream of S-334. When WCA-3A is in Zone E1 or above, maximum practicable through S-333 to NESRS per WCA-3A deviation schedule.
S-333: G-3273 > 6.8' NGVD	Closed	Match S-333 with S-334 flows
L-29 constraint	9.0 ft	9.0 ft
S-355A&B	Follow the same constraints as S-333. Open whenever gradient allows southerly flow.	Follow the same constraints as S-333. Open whenever gradient allows southerly flow.
S-337	Water Supply	Regulatory releases as per WCA-3A deviation schedule.
S-151	Water Supply	Regulatory releases as per WCA-3A deviation schedule.
S-335	Water Supply The intent is to limit the volume of water passed at S335 to pre-ISOP conditions and not use S332B, S332C, or S332D or other triggers to pass additional flows. Note: It is recognized that under	When making regulatory releases through S-151, limit S-335 outflows to not exceed inflows from the S-151/S-337 path Use S-333/S-334 before S-335/S-151/S-337

	these conditions operations of S-335 would be infrequent.	
S-334	Water Supply	Pass all or partial S-333 flows Depending on stage at G-3273
S-338	Open 5.8 Close 5.5	Open 5.8 Close 5.4
G-211 Tailwater constraint 5.3	Open 6.0 Close 5.5	Open 5.7 Close 5.3
S-331	Angel's Criteria	Angel's Criteria
S-332B Note 1: There will be two 125-cfs pumps and one 75-cfs pump directed to the west seepage reservoir. The remaining two 125-cfs pumps will be directed to the north seepage reservoir. Note 2: A new indicator will be established for Subpopulation F. Operations will be modifed as necessary to achieve desired habitat conditions consistent with the restoration purposes outlined in the C-111 GRR.	Pumped up to 575 cfs* On 5.0 Off 4.7** *Pump to capacity if limiting conditions within the Sparrow habitat are not exceeded. There will be no overflow into the Park when the project (i.e., the S-332B north seepage reservoir and the partial S-332B/S-332C connector) is complete and when it is practical to do the construction necessary to raise the western levee. There may be overflow during emergency events until the project is complete and the western levee is raised. **If, after the first 30 days of operation, there is no observed drawdown at the pump, this stage level will be raised to 4.8	Pumped up to 575 cfs* On 4.8 Off 4.5 *Pump to capacity if limiting conditions within the Sparrow habitat are not exceeded. There will be no overflow into the Park when the project (i.e., the S-332B north seepage reservoir and the partial S-332B/S-332C connector) is complete and when it is practical to do the construction necessary to raise the western levee. There may be overflow during emergency events until the project is complete and the western levee is raised.
S-332B North Seepage Reservoir	The north reservoir is the new 240-acre reservoir located to the north of the pump station with a weir discharging to the east. Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if the Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet when possible.	The north reservoir is the new 240-acre reservoir located to the north of the pump station with a weir discharging to the east. Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if the Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet when possible.
S-332B West Seepage	The west reservoir is the existing	The west reservoir is the existing

Reservoir	160-acre reservoir and is to the west of the pump station. There will be no overflow into the Park when the project (i.e., the S-332B north seepage reservoir and the partial S-332B/S-332C connector) is complete and when it is practical to do the construction necessary to raise the western levee. There may be overflow during emergency events until the project is complete and the western levee is raised. Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if the Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet.	160-acre reservoir and is to the west of the pump station. There will be no overflow into the Park when the project (i.e., the S-332B north seepage reservoir and the partial S-332B/S-332C connector) is complete and when it is practical to do the construction necessary to raise the western levee. There may be overflow during emergency events until the project is complete and the western levee is raised. Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if the Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet.
S332C The S-332C pump capacity is temporary. A new indicator will be established and a new gauge will be installed in Rocky Glades. Operations will be modifed as necessary to achieve desired habitat conditions consistent with the restoration of Taylor Slough based on the C-111 GRR.	Pumped up to 575 cfs* On 5.00 Off 4.70** * Pump to capacity unless habitat conditions are not being achieved within the Rocky Glades. There will be no overflow into the Park. **If, after the first 30 days of operation, there is no observed drawdown at the pump, this stage level will be raised to 4.8	Pumped up to 575 cfs* On 4.8 Off 4.5 * Pump to capacity unless habitat conditions are not being achieved within the Rocky Glades. There will be no overflow into the Park.
S-332C Seepage Reservoir	300 acres with overflow to the east Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if the Corps	300 acres with overflow to the east Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if the Corps

	determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet.	determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet.
S-332B/S-332C Connector	141 acres partial 206 acres full 1,262 acres with the land swap Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0' The Corps, FWS, ENP, and SFWMD will jointly develop a rule for emergency operations that is consistent with C-111 project purposes before the land swap B/C connector is used.	141 acres partial 206 acres full 1,262 acres with the land swap Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0'. The Corps, FWS, ENP, and SFWMD will jointly develop a rule for emergency operations that is consistent with C-111 project purposes before the land swap B/C connector is used.
S-332D	Pumped up to 500 cfs from Jul 16 (or the end of the breeding season, as confirmed by FWS) to Nov 31; 325 cfs from Dec 1 to Jan 31; and 165 cfs* from Feb 1 to Jul 15. Meet Taylor Slough Rainfall formula consistent with marsh restoration (No L-31W constraint) On 4.85 Off 4.65 *New information will be sought to evaluate the feasibility of modifying the 165 cfs constraint	Pumped up to 500 cfs from Jul 16 (or the end of the breeding season, as confirmed by FWS) to Nov 31; 325 cfs from Dec 1 to Jan 31; and 165 cfs* from Feb 1 to Jul 15. Meet Taylor Slough Rainfall formula consistent with marsh restoration (No L-31W constraint) On 4.7 Off 4.5 *New information will be sought to evaluate the feasibility of modifying the 165 cfs constraint
Frog Pond Seepage Reservoir	810 acres with overflow into Taylor Slough Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin.	810 acres with overflow into Taylor Slough Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin.

	This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to a maximum of 4.0 feet. However, a depth of 4.0 feet in the Frog Pond is not possible at this time due to the constraint of the S-332D pump station outlet elevation.	This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if Corps determines a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to a maximum of 4.0 feet. However, a depth of 4.0 feet in the Frog Pond is not possible at this time due to the constraint of the S-332D pump station outlet elevation.
S-332	Closed	Closed
S-175	Closed	Closed
S-194	Open 5.5 Close 4.8	Operated to maximize flood control discharges to coast Open 4.9 Close 4.5
S-196	Open 5.5 Close 4.8	Operated to maximize flood control discharges to coast Open 4.9 Close 4.5
S-176	Open 5.0 Close 4.75	Open 4.9 Close 4.7
S-177	Open 4.2 (see S-197 open) Close 3.6	Open 4.2 (see S-197 open) Close 3.6
S-18C	Open 2.6 Close 2.3	Open 2.25 Close 2.00
S-197	If S-177 headwater is greater than 4.1 or S-18C headwater is greater than 2.8 open 3 culverts If S-177 headwater is greater than 4.2 for 24 hours or S-18C headwater is greater than 3.1 open 7 culverts If S-177 headwater is greater than 4.3 or S-18C headwater is greater than 3.3 open 13 culverts Close gates when all the following conditions are met: 1. S-176 headwater is less than 5.2 and S-177 headwater is less than 4.2 2. Storm has moved away from the basin 3. After Conditions 1 and 2 are met, keep the number of S-197 culverts open necessary only to match residual flow through S-176. All culverts should be closed if S-177 headwater is less than 4.1 after all conditions are satisfied.	If S-177 headwater is greater than 4.1 or S-18C headwater is greater than 2.8 open 3 culverts If S-177 headwater is greater than 4.2 for 24 hours or S-18C headwater is greater than 3.1 open 7 culverts If S-177 headwater is greater than 4.3 or S-18C headwater is greater than 3.3 open 13 culverts Close gates when all the following conditions are met: 1. S-176 headwater is less than 5.2 and S-177 headwater is less than 4.2 2. Storm has moved away from the basin 3. After Conditions 1 and 2 are met, keep the number of S-197 culverts open necessary only to match residual flow through S-176. All culverts should be closed if S-177 headwater is less than 4.1 after all conditions are satisfied.
S-356	When conditions permit (i.e., G-3273 and L-29 constraints), discharges from S356 will go into L-29. Pumping will be limited to	When conditions permit (i.e., no S-334 regulatory releases and G-3273 and L-29 constraints), discharges from S356 will go into L-29.

	the amount of seepage into L-31N in the reach between S-335 and G-211. A technical team will evaluate pumping limits and operations. The pumps will be operated accordingly.	Pumping will be limited to the amount of seepage into L-31N in the reach between S-335 and G-211. A technical team will evaluate pumping limits and operations. The pumps will be operated accordingly.

Note: Prestorm drawdown will be the same as in the Oct 01 SDEIS with the additional language….

Operations for other than named events. SFWMD will monitor antecedent conditions, groundwater levels, canal levels and rainfall. If these conditions indicate a strong likelihood of flooding, SFWMD will make a recommendation to the Corps to initiate pre-storm operations. The Corps will review the data, advise ENP, FWS of the conditions, consult with the Miccosukee Tribe and make a decision whether to implement pre-storm drawdown or otherwise alter systemwide operations from those contained in the table.

Note: The Chairman of the Miccosukee Tribe of Indians of South Florida or his designated representatives, will monitor the conditions in WCA3A and other tribal lands and predicted rainfall. If the Tribe determines these conditions indicate jeopardy to the health or safety of the Tribe, the Chairman will make a recommendation to the Corps to change the operations of the S12 structures or other parts of the system. The Corps will review the data, advise appropriate agencies of the conditions, and the District Commander will personally consult with the Chairman prior to making a decision whether to implement changes to the S12 operations.

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LIST OF ACRONYMS

C-x	Canal
C&SF	Central and South Florida
CEQ	Council on Environmental Quality
cfs	Cubic Feet per Second
CSSS	Cape Sable Seaside Sparrow
DEIS	Draft Environmental Impact Statement
DERM	Department of Environmental Resources Management
EA	Environmental Assessment
EAA	Everglades Agricultural Area
EIS	Environmental Impact Statement
ENP	Everglades National Park
ESA	Endangered Species Act
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FFWCC	Florida Fish and Wildlife Conservation Commission
FONSI	Finding of No Significant Impact
G-x	Gaging Station or Culvert Structure
GDM	General Design Memorandum
HTRW	Hazardous, Toxic, and Radioactive Waste
IECR	Institute for Environmental Conflict Resolution
IOP	Interim Operational Plan
ISOP	Interim Structural and Operational Plan
L-x	Levee
LEC	Lower East Coast
LOSA	Lake Okeechobee Service Area
MWD	Modified Water Deliveries to Everglades National Park
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum
NOI	Notice of Intent
NPS	National Park Service
NESRS	Northeast Shark River Slough
PL	Public Law
S-x	Pump Station, Spillway, or Culvert
SDCS	ENP/South Dade Conveyance System
SFWMD	South Florida Water Management District
SMA	Square Mile Area
SRS	Shark River Slough
SSM	Supply Side Management
USACE	U.S. Army Corps of Engineers
FWS	U.S. Fish and Wildlife Service
FWS RPA	U.S. Fish and Wildlife Service Reasonable and Prudent Alternative
FWS B.O.	U.S. Fish and Wildlife Service Biological Opinion
WCA	Water Conservation Area

1.0 PURPOSE AND NEED FOR THE CONSIDERED ACTION

1.1 Project Authorization

A minimum schedule of water deliveries from the Central and Southern Florida (C&SF) Project to the Everglades National Park (ENP) was authorized by Congress in 1969 in Public Law (PL) 91-282. Section 1302 of the Supplemental Appropriations Act of 1984 (PL 98-181), passed in December 1983, authorized the U.S. Army Corps of Engineers (Corps), with the concurrence of the National Park Service (NPS) and the South Florida Water Management District (SFWMD), to deviate from the minimum delivery schedule for two years in order to conduct an Experimental Program of water deliveries to improve conditions within the ENP. Section 107 of PL 102-104 amended PL 98-181 to allow continuation of the Experimental Program until modifications to the C&SF Project authorized by Section 104 of the ENP Protection and Expansion Act of 1989 (PL 101-229) were completed and implemented. PL-101-229 eventually led to the Modified Water Deliveries (MWD) Report and Project (USACE 1992). The MWD Project is scheduled to be completed in 2003, and would provide for increased water deliveries to the Park through a route that more closely approximates the original historic flow-way down the center of Northeast Shark River Slough (NESRS).

Test Iteration 7 of the Experimental Program of Modified Water Deliveries to ENP (herein referenced as the 1995 Base) was initiated in October 1995 (USACE 1995). In February 1999, the U.S. Fish and Wildlife Service (FWS) issued a Final Biological Opinion (B.O.) under provisions of the Endangered Species Act (ESA), which concluded that Test 7, Phase I was jeopardizing the continued existence of the Cape Sable seaside sparrow (CSSS). They further concluded that ultimate protection for the species would be achieved by implementing the MWD to ENP project (PL 101-229) as quickly as possible. In the opinion of the FWS, the FWS B.O. presented a Reasonable and Prudent Alternative (RPA) to Test 7, Phase I of the Experimental Program that would avoid jeopardizing the CSSS during the interim period leading up to completion of the MWD project. The FWS RPA recommended that certain hydrologic conditions be maintained in the sparrow's breeding habitat to avoid jeopardizing the continued existence of the species. In January 2000, the Experimental Program was terminated, and in March 2000, Test 7, Phase I was replaced by the current Interim Structural and Operational Plan (ISOP) (USACE 2000). The ISOP was designed to meet the conditions of the FWS RPA included in the FWS B.O. from March 2000 until implementation of the Interim Operational Plan (IOP). The Corps was recently authorized by Council for Environmental Quality (CEQ) to conduct emergency operations under ISOP 2001 for the 2001 nesting season. The ISOP will be in place until completion of the EIS and a Record of Decision (ROD) is signed for the Interim Operational Plan (IOP). Once the ROD is signed, the IOP would replace the ISOP and continue FWS RPA protective measures for the CSSS until implementation of the Combined Structural and Operational Plan (CSOP) project after appropriate NEPA documentation and signing of the ROD.

1.2 Project Location

The C&SF system-wide project is located in South Florida and includes portions of several counties as well as portions of the ENP, Big Cypress National Preserve, and adjacent areas (Figure 1). The Corps' June 1992 General Design Memorandum (GDM) titled "Modified Water Deliveries to ENP," defines the project boundary as Shark River Slough and that portion of the C&SF Project north of S-331 to include Water Conservation Area 3 (WCA 3). The major project components of the MWD and C-111 projects are shown in Figure 2.

1.3 Project Purpose

On 19 February 1999, the FWS issued a Final FWS B.O. for the MWD project, Experimental Water Deliveries Program, and C-111 Project under provisions of the Endangered Species Act of 1973, as amended. The FWS B.O. concluded that continuation of Test 7, Phase I operations would cause adverse modification of CSSS critical habitat and would jeopardize the continued existence of the CSSS. Currently, six such population clusters of the CSSS are known and are distributed within the southernmost portion of the C&SF project area (Figure 3). The operating criteria for Test 7 were defined in a concurrency agreement between the Corps, ENP, and the SFWMD in October 1995. Test 7 was to be implemented in two phases. Phase I consisted of operating the structures in place at that time until Phase II structures could be completed. The ultimate goal of Test 7 was to improve the timing, volume, and location of water deliveries to ENP to more closely reflect natural pre-development flows. The FWS B.O. also concluded that ultimate protection for the CSSS would be achieved by the rapid completion and implementation of the MWD project. The current ISOP is designed to take the place of Test 7 until completion and implementation of the IOP. The IOP would avoid jeopardizing the CSSS during the interim period (2002 and 2003) leading up to MWD implementation.

In the opinion of the FWS, the FWS B.O. presents a Reasonable and Prudent Alternative (RPA) to the Experimental Program that would avoid jeopardizing the CSSS. The FWS RPA recommends that the following hydrological conditions be met for protection of the CSSS: 1) A minimum of 60 consecutive days of water levels at or below 6.0 feet NGVD at NP 205 between March 1 and July 15; 2) Ensure that 30%, 45%, and 60% of required regulatory releases crossing Tamiami Trail enter ENP east of L-67 extension in 2000, 2001, and 2002, respectively, or produce hydroperiods and water levels in the vicinity of subpopulations C, E, and F that meet or exceed those produced by the 30% , 45% , and 60% targets; and 3) Produce hydroperiods and water levels in the vicinity of subpopulations C, E, and F that equal or exceed conditions that would be produced by implementing the exact provisions of Test 7, Phase 2 operations (USACE 1995). During implementation of the ISOP, the Corps received confirmation from the FWS that producing the hydrologic equivalent of the 30%, 45%, and 60% conditions, as opposed to the actual release percentages, would also meet the FWS RPA conditions.

The proposed actions would allow the Corps to meet the FWS RPA conditions and minimize impacts to other natural and human resources, while managing the system for purposes authorized under the C&SF Project.

1.4 Related Environmental Documents

A number of actions relevant to the proposed action have been implemented since the 1983 Experimental Program was authorized. The following list identifies milestones leading up to the proposed action. Some of the key environmental documents relevant to the proposed action are the Final ISOP EA, Final SEIS on the 8.5 SMA and Test 7 Summary. The Corps is currently operating under the ISOP. The Final Environmental Assessment (EA) for the ISOP was issued in March 2000. A critical component to implementing the actions recommended in the FWS B.O. is the protection of the 8.5 Square Mile Area (SMA), a residential area located to the east of Northeast Shark River Slough (NESRS). A Final SEIS was prepared and coordinated in August 2000 for implementation of a preferred alternative that consists of perimeter and interior levees as well as a seepage canal. A new proposed pumping structure (S-357) located at the southern terminus of the seepage canal would discharge seepage water into a treatment area located south of Richmond Drive in the C-111 project area. The ROD for the 8.5 SMA SEIS was signed on December 6, 2000.

Date	Action
1983	Authorization of the Experimental Program
1989	ENP Protection and Expansion Act of 1989
1990	Draft General Design Memorandum (GDM) on Modified Water Deliveries
1990	Biological Opinion on Modified Water Deliveries
1992	Final GDM on Modified Water Deliveries
1993	Implement Test 6 of the Experimental Program
1994	C-111 General Reevaluation Report
1995	Biological Opinion Test 6, Experimental Program
1995	Extension of Test 6
1995	Implement Test 7, Phase I of the Experimental Program
1995	Initiate Test 7 Hydrologic and Ecological Monitoring
1997	FWS Request Corps to reinitiate Section 7 consultation
1998	Implement 1998 Emergency Deviation from Test 7, Phase I
1999	Biological Opinion on the Experimental Program, Modified Water Deliveries, and C-111 Project
1999	Implement Emergency Deviation from Test 7, Phase I
2000	Implement ISOP 2000 Emergency Deviation
2000	8.5 SMA Plan Final SEIS and ROD
2001	Completion of Test 7 Hydrologic and Ecological Monitoring Report
2001	Implementation of ISOP 2001 Emergency Deviation
2001	Draft EIS for the Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow
2001	Supplemental Draft for the Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow
2002	C-111 Final Integrated GRR Supplement, Environmental Assessment, and FONSI

As part of the interagency agreement that accompanied approval of Test Iteration 7 of the Experimental Program of Water Deliveries to ENP, the Corps participated in a monitoring program to determine the ecological and hydrologic benefits of the program. The monitoring program evaluated changes in hydrologic conditions beginning in November 1995 through May 2000. In addition, ecological factors that included freshwater fish and macroinvertebrates; mangrove resident fish; wading birds; CSSS; and American crocodile were monitored to determine the effects of the Test 7 Experimental Program on natural resources in the ENP.

At the December 17, 1999 emergency meeting of the SFWMD Governing Board, the Corps presented the ISOP, which was prepared to modify hydrologic conditions in ENP to avoid jeopardizing the CSSS. In a letter to the Corps dated January 20, 2000, the SFWMD stated:

. *"The ISOP explicitly represents a departure from Test Iteration 7 of the Experimental Program of Water Deliveries to Everglades National Park operating criteria: consequently, the three-party concurrency agreement established for Test Iteration 7 cannot adequately facilitate implementation of the ISOP. Based upon your briefing that the requirements of the biological opinion for the CSSS now supercede the management objectives of the Experimental Program, we realize the Experimental Program has been effectively terminated."*

At that point, Test Iteration 7 of the Experimental Program was terminated and replaced by the ISOP. An EA was prepared for ISOP 2000, which provided a plan for operations to meet the requirements of the B.O. during 2000. ISOP 2001 provides for current operations of water deliveries to the ENP.

The Corps issued a Draft EIS for the Interim Operational Plan (IOP) for the Protection of the Cape Sable Seaside Sparrow in February 2001, which assessed six alternatives. Comment letters and Corps responses are included in Appendix D. Due to the number of issues which were still unresolved after public coordination of the DEIS, the Corps was directed by CEQ to work with the various agencies to formulate a consensus plan which would meet the B.O. requirements while satisfying other authorized C&SF Project purposes. At the suggestion of the President's Council on Environmental Quality (CEQ), the Corps engaged the services of the U.S. Institute for Environmental Conflict Resolution (IECR) to facilitate the development of an improved plan to address the FWS' concerns. A number of facilitated meetings and teleconferences were held between the FWS, ENP, and the South Florida Water Management District (SFWMD) from May through August, 2001, to resolve issues regarding the IOP. As a result of this process, an additional alternative (Alternative 7) was developed for review under the NEPA process, and a Supplemental DEIS was issued in October 2001. Comment letters and Corps responses are included in Appendix E.

During the review process and based on letters from various stakeholders, it was decided to further develop Alternative 7 to provide additional flood control capacity because it appeared that Alternative 7 might result in an increased risk of flooding in agricultural

areas located east of the L-31 levee in comparison to present conditions. The Corps, in consultation with the FWS, ENP, and the SFWMD, determined that construction of previously approved components of the MWD and C-111 projects would provide flexibility to the system operations to maintain current flood protection capacity. The preferred alternative evaluated in the SDEIS, Alternative 7, was adjusted to utilize these components, and it was determined that a Final EIS could be issued with Alternative 7R. This alternative would become the recommended plan.

1.5 Scoping

A Scoping Letter was issued to various stakeholders and interested parties on October 26, 1999 and comments were received through November 30, 1999. A public scoping meeting was held in Homestead, Florida on November 16, 1999 to elicit comments and determine issues to be resolved during the NEPA process. Interagency meetings were held on April 10, 2000 and May 15, 2000 to discuss project operations and to finalize alternatives to be evaluated in the EIS. In addition, the Corps posted hydrologic model runs and hydrographs of potential alternatives on its website for review by all interested parties. An additional Public Workshop was held in Homestead, Florida on June 7, 2000 to elicit public comment and inform the public of project developments.

In accordance with the Council for Environmental Quality (CEQ) letter dated December 25, 2000, an additional Public Workshop was held January 30, 2001 to relay to the public that Phase 1 of the IOP preferred alternative would be the ISOP for 2001. On July 16, 2001, a public workshop was held to discuss Alternative 7. In addition, several stakeholder meetings were held throughout the summer and fall 2001 regarding the IOP.

Both the Florida Fish and Wildlife Conservation Commission (FFWCC) and Florida Department of Environmental Protection (FDEP) expressed concerns about potential effects of the project on the ecological conditions of the WCAs, which are managed by the state. In particular, the agencies were concerned that storage of additional water in these areas as a consequence of reduced releases through the S-12 structures could cause loss of valuable habitat. The agencies also expressed concerns about freshwater pulses into estuary systems. The FFWCC provided a number of recommendations to be considered during the selection of the final alternative plan and requested that the Corps coordinate with them during the selection process.

A letter from the Natural Resources Defense Council (NRDC) recommended that technical staff members from ENP, FWS, and SFWMD be included in the formulation of the IOP and EIS. The NRDC also provided recommendations regarding the analysis of regulatory releases, mitigation, impacts to private property, and coordination with other interest groups. A number of potentially affected property owners also commented regarding adequate compensation for their property from the National Park Service acquisition process associated with the ENP Expansion.

Figure 1 Project Location

Figure 2 Project Features Map

Figure 3 Sparrow Population Locations

2.0 ALTERNATIVES

2.1 Background

Representatives from the Corps, FWS, FFWCC, ENP, SFWMD, DERM, FDEP, and FDACS evaluated a number of options that had potential as solutions in satisfying the project purpose. These options included changes in operational criteria for existing structures throughout the region that could influence water levels within the various sparrow subpopulations. Two interagency modeling meetings were held to discuss potential options for meeting the criteria stated in the USFWS B.O. and to evaluate modeling runs produced by the Corps prior to the meetings. Changes in the operation of various structures were proposed during the meetings and in subsequent correspondence, and appropriate model runs were produced. The modeling runs were posted on the Corps Jacksonville District Website (http://www.saj.usace.army.mil) as each was produced. The interagency review team members were informed as the model runs were posted, and comments and suggestions were used to modify the potential alternative plans. The alternative model runs were compared to the 1995 Base conditions, which represents conditions under normal C&SF operations with Test 7, Phase I operations in the ENP/South Dade Conveyance System (SDCS) prior to Emergency Deviations and ISOP.

The federal agencies requested facilitators from the U.S. Institute for Environmental Conflict Resolution to assist the Corps, SFWMD, FWS and ENP to reach a consensus on a preferred alternative. On July 18, 2001, after four months of negotiation, the interagency team reached a consensus on a proposal for the IOP. This proposal was modeled using the SFWMM version 3.8 as Alternative 7.

Alternative 7, the "preliminary recommended plan" presented in the October 2001 Supplemental Draft EIS, has been revised to better address flood protection for developed lands east of the L-31N Canal. The final recommended plan is now Alternative 7R, as described in detail in later paragraphs. Modifications to Alternative 7 were developed in response to comments submitted by the public and cooperators on Alternative 7. The stakeholders including the SFWMD and agricultural interests commented that the existing capability for flood control in the agricultural and residential areas potentially affected by the project must be maintained. With the existing water management infrastructure, the higher L-31N Canal stages that would result from Alternative 7 would not allow for sufficient draw-down of groundwater levels in advance of significant impending storms to meet this criterion. Consequently, Alternative 7 would result in an increased risk of flooding over the present conditions.

To address this concern, Alternative 7R provides increased capability to draw down groundwater levels when a significant storm is predicted, while retaining all of the sparrow protection features of Alternative 7. The increased capability is obtained by constructing pump station (S-332C) and seepage reservoirs along the L-31N Canal to supplement the capacity of S-332B to lower canal and groundwater levels. The pump

stations draw water out of the canal, thus lowering adjacent groundwater levels. The water is pumped into reservoirs along the eastern boundary of the Park. Some of the pumped water would return to the canal via seepage, but there is expected to be a net gain in lowering canal stages. During non-storm conditions, the pump stations would be operated at reduced capacity to maintain a water depth in the reservoirs necessary to create a continuous hydraulic ridge along the Park boundary for seepage control. This hydraulic ridge concept was developed in the authorized C-111 project. The pumping would be adjusted seasonally to maintain the desired water conditions in sparrow habitat within the Park conducive to breeding and habitat maintenance. In conjunction with these features along L-31N, the authorized S-356 pump station is being constructed in the Tamiami Canal where it can be used to collect seepage from ENP along the reach of the L-31N canal which extends from S-335 to G-211 by pumping water west behind the existing S-334 structure and thence into NESRS when conditions permit.

All of these structural elements, which are presently under construction, are authorized features of the MWD and C-111 projects, and have been addressed in previous NEPA documents associated with those projects. As such, they are not proposed features of Alternative 7R. Their construction has been scheduled in conjunction with evaluation of Alternative 7R, and their operation is being addressed in this EIS. To have their construction completed and to be ready for operation under IOP by the time a Record of Decision has been signed for this EIS, these components are being constructed as interim structures. Capacity and operations will be assessed under the Combined Structural and Operational Plan (CSOP) now under development and expected to be implemented in several years.

2.1.2. Base Conditions

The water management operations existing before Emergency deviations and ISOP were known as 95Base which included Test 7 Phase I. This base condition was modeled using SFWMM version 3.8 and was compared to the RPA, ISOP 2000, ISOP 2001, and IOP alternatives. In the latest regional computer modeling, 95Base was modified to include the use of S-355A&B and as a result, it was renamed 95Base Modified 2 (95BM2). Operational assumptions used to simulate 95BM2 are listed in Table 2.1.

2.1.3. RPA Hydrologic Condition Requirements

The FWS B.O. has specific RPA requirements for western and eastern habitats of the CSSS for years 2000, 2001 and 2002. For the western habitat, it stated that the Corps must prevent water levels at NP-205 from exceeding 6.0 feet NGVD for a minimum of 60 consecutive days between March 1 and July 15. For the eastern habitat, the B.O. requires that the Corps must implement actions that would produce hydroperiods and water level in the vicinity of CSSS subpopulations C, E, and F, equal to or greater than those that would be produced by implementing the exact provisions of Test 7 Phase II. In addition, it specified that the Corps must provide at least 30, 45, and 60 percent of all

regulatory water releases crossing Tamiami Trail enter ENP east of the L-67 Extension in 2000, 2001, and 2002, respectively.

With these RPA requirements, the Corps developed RPA100, RPA101, and RPA102 model runs to represent the conditions required by the B.O. for 2000, 2001 and 2002. These RPAs were replaced by RPA00, RPA01, and RPA02 because of improved operations of S-12 structures, the use of S-355A&B, and adjustment to WCA 2 and WCA 3A regulation schedules. Operational assumptions used in the modeling of these RPAs are listed in Table 2.2.

2.2. Description of Alternatives

Six plans were originally selected for evaluation in the DEIS. One additional plan (Alternative 7) was selected for evaluation in the SDEIS. Alternative 7R is essentially the same as Alternative 7, but the evaluation includes operation of components of previously approved C-111 and MWD projects to provide additional operational flexibility. In addition, descriptions and operational components of the ISOP 2000 and ISOP 2001 (No Action Alternative) plans were provided for comparison in the SDEIS (Tables 2.3 and 2.4, respectively). The ISOP 2000 and ISOP 2001 were included to provide a basis of comparison as well as to include an analysis of these plans in the EIS.

2.2.1 Alternative 1 (No Action).

Alternative 1 (also known as ISOP9dR) represents the model run for ISOP 2001. It is considered to be the No Action alternative because 95Base (Test 7 Phase I) caused jeopardy to the CSSS according to the FWS B.O. The goal of Alternative 1 is to meet the RPA requirements for 2001. The plan is to provide water levels at NP-205 below 6.0 feet NGVD for a minimum of 60-consecutive days between March 1 and July 15; and at the same time, produce hydrologic equivalence to the RPA hydroperiods that would be produced by implementing Test 7 Phase II in SDCS and discharging increasing percentages of all regulatory releases crossing Tamiami Trail to enter ENP east of the L-67 Extension. Operational assumptions used in the modeling of Alternative 1 are listed in Table 2.4. Modeling results that indicate Alternative 1 meets and exceeds the RPA hydroperiod requirements for the eastern sparrow habitat, specifically under the hydroperiod frequencies performance measure. The operational plan for Alternative 1 is depicted on Figure 4 and its structural and operational features are described as follows.

In Alternative 1, basic water management operations for flood control and water supply in SDCS have not changed significantly from 95Base (Test 7 Phase I). Canal levels in the northern reach of L-31N, from S-331 up to S-334, L-30, from S-335 to S-337, and C-4 are unaffected by operational changes in this alternative. The new components that set Alternative 1 apart from 95Base (Test 7 Phase I) are the regulation schedule deviation for WCA 3A; closure dates for the S-12A, S-12B, S-12C, S-343A, S-343B, and S-344; two new pump stations, S-332B and S-332D; and lower canal levels along the L-31N reach between S-331 and S-176.

To meet the requirement for ensuring that water level stays at or below 6.0 ft NGVD at Gage NP-205 for at least 60-consecutive days, the Corps determined through regional modeling that staggered closures at S-343A&B, S-344, and S-12A, S-12B, and S-12C starting on November 1 through February 1 and returning these structures to normal operation after July 15 would maximize the potential for nesting success for sparrow sub-population A. Gage NP-205 is located in the western marl prairies and is the key station for monitoring water levels in the Western Shark River Slough.

To achieve the hydrologic equivalence to the hydroperiods required by the FWS B.O. for the eastern marl prairies (sparrow sub-population C, E, and F habitats) and at the same time, maintain C&SF project goals and responsibilities, the Corps proposed to route regulatory releases from WCA 3A, that normally would be discharged directly through the western structures, through S-333 and S-334 structures, down L-31N canal, and into a 160-acre seepage reservoir through S-332B pump. According to the regional modeling using SFWMM, when capacity is available S-332B must be pumped up to 325 cfs in order to meet the RPA requirements. The routing of WCA 3A waters through SDCS would require the lowering of L-31N canal from S-331 to S-176 and maximizing excess discharges to tide.

2.2.2 Alternative 2

Alternative 2 (Table 2.5) was developed to further improve conditions in the eastern sparrow populations over those under the No Action alternative, while also improving environmental conditions within other affected regions of the project area. It was decided that IOP alternatives must be formulated in two phases; Phase 1 would be in effect prior to the completion of the 8.5 SMA Project; and Phase 2 would take effect once construction of the 8.5 SMA was completed. For the modeling of the IOP, it was assumed that as a result of the implementation of the 8.5 SMA solution, the G-3273 trigger was no longer in effect.

Phase 1 of Alternative 2 (IOP 2b) differs from the No Action Alternative (ISOP 9dR) in the following ways. IOP 2b includes a deviation to the WCA 2A regulation schedule; the S-343 A/B and S-344 structures would close two months later on January 1; S-12A would close one month later on December 1; S-12D would close from February 1 to July 15; the schedule for S-333 would vary; and in pumping schedules for S-332B and S-332D.

Phase 2 of Alternative 2 (IOP 2) differs from the No Action Alternative (ISOP 9dR) by: allowing S-333 to deliver water to NESRS via L-29 at a rate up to its structural capacity when the G-3273 gage is higher than 6.8 feet; close the S-334 structure during regulatory releases from S-333; and incorporate the same changes as Phase 1 (IOP 2b) at S-332B and S-176.

2.2.3 Alternative 3

Alternative 3 (Table 2.6) also has two phases for the same purpose as Alternative 2, with Phase 1 being implemented prior to the 8.5 SMA Project completion and Phase 2 implemented after completion of 8.5 SMA Project.

Phase 1 of Alternative 3 (IOP 2a) is similar to Phase 2 of Alternative 2 (IOP 2) with one exception; S-333 would be closed when the G-3273 gage is higher than 6.8 feet. Phase 2 of Alternative 3 (IOP 2) is the same as Phase 2 for Alternative 2.

2.2.4 Alternative 4

Alternative 4 (Table 2.7) (IOP 3 and IOP 3a) is also implemented in two phases and is similar to Alternative 2 (IOP 2 and IOP 2a) with the exception that the S-12 structures A, B, C, and D and the S-343/S-344 structures would be closed earlier in the year, from November 1 through July 15. IOP 3a would be implemented as Phase 1 and IOP 3 would be implemented as Phase 2.

2.2.5 Alternative 5

Alternative 5 (Table 2.8) (IOP 4a and IOP 4 resembles the No Action Alternative (ISOP 9dR) to a greater degree than do either Alternative 2 or Alternative 3 since this alternative was developed after ISOP 9dR was produced. Alternative 5 (Phase 1) and the No Action alternative differ only regarding the S-332B pumping schedule and the S-176 schedule. Phase 2 also includes the removal of the G-3273 trigger.

2.2.6 Alternative 6

Alternative 6 (Table 2.9) is identical to Alternative 5 with two exceptions: an additional 240 acre seepage reservoir with weir overflow designed to flow back into L-31N canal and maximum pumping is limited to 250 cfs at S-332B pump station (Figure 4). The purpose of adding a new 240-acre reservoir is to minimize direct weir overflow into the ENP. By reducing pumping from 325 cfs to 250 cfs, potential weir overflow would be reduced. According to the regional modeling from SFWMM version 3.8, pumping up to 250 cfs at S-332B would still meet and exceed RPA hydroperiod requirements for sub-populations E and F. The size of the first seepage reservoir is approximately 160 acres. Field data suggests that in the dry season, the existing 160-acre seepage reservoir can seep up to 190 cfs, and in the wet season, the seepage rate is reduced to about 120 cfs. Based on this field data and limited and preliminary sub-regional modeling, the combined 400-acre seepage reservoir was projected to be able to seep over 250 cfs of discharge from S-332B without direct weir overflow into the park from normal operations. Once the new seepage reservoir is constructed, a more accurate rate of seepage can be obtained. The additional seepage reservoir is proposed to be built north of the current seepage reservoir and is designed with overflow weir on the east side to allow for potential

overflow back into L-31N canal. Although the existing seepage reservoir could be affected by the combined operation at these two seepage reservoirss, the north-south orientation of the new reservoir would be more conducive to seepage to the ENP. Furthermore, the depth of the new reservoir is more than twice that of the existing reservoir. A table comparing SFWMM cell size and the current and proposed seepage reservoirs is shown below.

	Area (acres)
2 mile x 2 mile cell	2,560
1st Seepage reservoir	160
2nd Seepage reservoir	240

The seepage reservoirs were not modeled explicitly because of the limitation of the SFWMM version 3.8. However the amount of water being delivered to the modeled cell is correct. According to the model algorithm, SFWMM basically spreads inflow from S-332B pump over an entire grid cell. In terms of evaluating long-term hydrologic impacts associated with overland flow, the model is an appropriate tool to use in the determination of water management operations that would produce hydroperiods that would meet the RPA requirements. Modeling results indicate that Alternative 6 would meet and exceed the RPA hydroperiod requirements for the eastern sparrow habitat. Detailed operational assumptions used in the regional water management modeling of Alternative 6 are listed in Table 2.9.

2.2.7 Alternative 7

Alternative 7 (Table 2.10) represents the IOP consensus proposal from the Corps, ENP, USFWS, and SFWMD collaborative process. Its most important feature that sets it apart from other alternatives is the dual mode of water management operations. In addition, Alternative 7 has three structural modifications.

Dual Mode of Operations

The dual mode of operations was derived by recognizing some fundamental operational issues in the plan. When the S-12 operations are reduced in order to decrease impacts to the western Cape Sable seaside sparrow habitats, the potential exists to increase water levels in WCA3A. The ISOP addressed this by moving some of the regulatory releases that cannot be passed through S-12D into the South Dade Conveyance System rather than directly onto western sparrow habitats. In order to mitigate for the increased inflow to the South Dade Conveyance System, the ISOP canal stages in the South Dade Conveyance System are lowered relative to Test 7 Phase I of the Experimental Water Deliveries. However, in the ISOP, these mitigation actions are implemented regardless of whether or not flow from WCA3A is entering the South Dade Conveyance System. According to the Department of the Interior (Coordination Act Report, p.126-129), these continuously lowered canal stages adversely impacted wetlands near L-31N. Alternative 7 addresses this concern by mitigating for the increased flow into the South Dade

Conveyance System only when that action is occurring. This operational philosophy results in the operational rule set in Table 2.10.

The first mode of the operation rule set of Alternative 7 is designated as “No WCA 3A regulatory releases to SDCS” operation. During these times, the L-31N canal would be maintained at Test 7 Phase I level when there are no WCA 3A regulatory releases. This operation was proposed to address the concern from DOI that maintaining L-31N canal at ISOP level would impact Park resources in NESRS.

The second set of operational rules which would apply when water is flowing from WCA 3A down and around the SDCS is called "WCA 3A regulatory releases to SDCS." During this operational phase, levels in L-31N canal would be lowered to minimize potential flood impacts in SDCS and at the same time, provide necessary downstream gradient to move some of WCA 3A regulatory releases through S-333/S-334, down through L-31N canal and to the S-332B pump station. The purpose of routing of regulatory releases from WCA 3A to S-332B seepage reservoir is to produce the hydrologic equivalence to the RPA hydroperiods in the habitats of sparrow sub-populations C, E and F to provide adequate hydration in these habitats until MWD is operational. Because the SFWMM cannot simultaneously simulate two different modes of water management operations that depend on hydrologic conditions in WCA 3A, Alternative 7 was modeled in two separate runs. Hence the model run simulating the "No WCA 3A regulatory releases to SDCS" is ALT7a and the "WCA 3A regulatory releases to SCDS" is ALT7b.

New Structural Features

Three structural modifications in Alternative 7 are degrading the lower 4 miles of the L-67 extension levee, constructing an additional 240-acre seepage reservoir at S-332B, and extending an additional 30 feet of S-333 spillway apron.

The degradation of the lower 4 miles of L-67 extension levee would allow water from Northeast Shark River Slough (NESRS) to flow into the northern part of Shark River Slough (NESRS) and northern habitat area of sparrow sub-population E. According to the DOI, degrading the lower section of L-67 Extension would enhance hydroperiods in CSSS sub-population E and water flows and volumes in Shark Slough and the Shark Slough estuaries. Various lengths of the degradation were proposed and only 2, 4, and 6-mile sections were evaluated. Degrading a four-mile section was selected based on the results of the modeling that show a potential hydroperiod improvement in the western part of NESRS with minimum impact to ground water level in and around 8.5 SMA. Modeling results and the potential impacts due to L-67 Extension degradation are shown in SDEIS Engineering Appendix from page A-94 to 101.

Building an additional seepage reservoir of 240 acres at S-332B would avoid direct overflow into the Everglades National Park. The current seepage reservoir is about 160 acres and has an average seepage rate of about 120 cfs during the wet season and about 190 cfs during the dry season. Cumulatively, both the existing 160-acre seepage reservoir and the new 240-acre detention (total of 400 acres) are 2.5 times larger than the

existing seepage reservoir. Additionally, the new seepage reservoir is more than twice as deep as the original reservoir. Therefore, it is reasonable to estimate that the combined seepage reservoirs of 400 acres would seep at least 250 cfs more than the amount needed to meet the RPA targets without direct weir overflow. In addition, the new seepage reservoir weir would be constructed to overflow to the east, not into the ENP. Therefore, with the additional seepage reservoir and the reduction of pumping at S-332B from 325 cfs to 250 cfs, the potential for and frequency of weir overflow into the Park during normal operations would be significantly reduced. Overflow into the Park under pre-storm/storm/storm recovery operation would depend on several factors whose recurrence frequency cannot be predicted reliably. These factors are:

- Rainfall recurrence probability;
- Antecedent stages in canals;
- Groundwater or surface water levels;
- Antecedent rainfall.

Although the Corps can estimate the recurrence frequency of a given rainfall event based on long term meteorological records, it cannot predict the other three conditions with confidence. Therefore, it is difficult to project the frequency or duration of such overflow events. However, during the 31 year period of record, there were 44 tropical storms that could have triggered the pre-storm operations, but only if other antecedent conditions were appropriate. The pre-storm operation was not modeled in the regional simulation of Alternative 7a and 7b but the modeling results indicate that during the 31 year period of record, the L-31N canal stage above S-174 would exceed 5.1 feet 2% of the time, at which time S-332B would be triggered to pump up to 500 cfs causing weir overflow into the Park (see page A-102 in the SDEIS Engineering Appendix).

The purpose of extending an additional 30 feet of the S-333 spillway apron is to prepare the structure for future operations when the levee system designed to protect 8.5 SMA is built. According to DOI, the environmental objective of increasing discharge at S-333 from 1,350 cfs to 2,000 cfs is to allow more water into NESRS. The Corps suggested that in order to safely pass this flow increase through S-333, the existing spillway apron would need to be extended for an additional 30 feet. The operational constraints are still the 6.8 feet NGVD trigger at G-3273 and 9.0 feet NGVD canal level in L-29. Detailed operational assumptions used in the water management simulation of ALT7a and ALT7b are shown in Table 2.10. A graphic depiction of water management is provided in Figure 6.

The S-332B north seepage reservoir continues to be included in this FEIS for completeness and tracking, as it was included in the IOP SDEIS. However, this feature has been adequately covered in the 1994 and 2002 NEPA documents on the C-111 project to allow its immediate construction, since once ESA consultation with FWS has now been completed for this reservoir.

As an integral part of IOP Alternative 7, S-335 would continue its primary function as a supplemental water deliveries structure with no change in operational triggers from Test

7 Phase I of the Experimental Water Deliveries Program except when making S-151 regulatory releases; this operational decision should be based on first meeting the priority given to S-334 and then matching flow through S-335 with inflows from S-151 and S-337. Stage and flow hydrographs at S-335 for period of record from January 1984 to June 2001 are shown page A-93 of the SDEIS Engineering Appendix. From reviewing and analyzing these hydrographs, the interagency team recognized that capacity for flow from S-335 into SDCS has not increased and concluded that any change in capacity would be designated for routing WCA 3A regulatory releases.

2.2.8 Alternative 7R

Alternative 7R (Table 2.11) evolved to overcome concerns regarding Alternative 7. Alternative 7, while trying to meet environmental objectives, still has the primary goal of routing regulatory releases from WCA 3A through SDCS to the sparrow habitats on the eastern side of the ENP. Even though the current regional modeling for South Florida is limited to a single mode of operation, Alternative 7 had to be simulated in two separate simulations to bracket the range of hydrological impacts to WCAs, ENP, and SDCS. However, unintended consequences and unforeseen impacts may happen outside the predicted range; therefore, additional structures and changes to operations may be needed to mitigate such problems.

As a result of discussions on addressing the comments received regarding IOP Alternative 7, the agency principals agreed to recommend an action plan that would incorporate adaptive management, planning-to-construction engineering, and flexible water management operations. The key element that would allow this new method of solving problems in South Florida would required the construction of S-356 pump station of MWD project and the S-332C seepage reservoir of the C-111 project. The S-356 pump station would be built at the exact location specified in MWD General Design Memorandum. Its primary function in this IOP is to collect seepage in L-31N canal north of G-211 and discharge it into L-29 canal only when G-3273 is below 6.8 feet NGVD. This seepage management plan would reduce flooding impacts to South Dade agricultural and urban areas due to the movement of seepage water from the ENP into L-31N canal. In addition, the agricultural stakeholders expressed a desire to continue the use of S-356 when G-3273 is above 6.8 feet NGVD. This poses as a problem to the residents of 8.5 SMA because when G-3273 is above 6.8 feet NGVD, any additional water added to L-29 could adversely affect the area.

As for the building of some of the C-111 features, the Corps would build one new pump station and three new seepage reservoirs (Figure 5). Operation of these features proposed by the principals of the agencies were included to mitigate for any potential flooding impacts due to higher canal levels in IOP compared to those in ISOP or any water quality concerns associated with direct discharges of flood water into the Park from pre-storm/storm/storm recovery management operations. The construction and operation of these structures would be conducted in phases with built-in real-time monitoring and intensive computer modeling to ensure that current flood control capability would not be

reduced or no further degradation to the natural resources in the Everglades National Park would occur.

Alternative 7, described in the supplemental draft EIS published in October 2001, was improved to include operation of MWD and C-111 features and is now known as IOP Alternative 7R or the recommended plan. In the actual implementation of IOP Alternative 7R, any future unintended consequences or unforeseen negative impacts to current flood control capability, cultural resources in WCA 3A, or natural resources of the Everglades National Park would be mitigated or addressed with vigorous adaptive management that includes, but is not restricted to, unrestricted flow and exchange of field data, modeling information, and real-time operational strategy among the agencies.

In Alternative 7R, pre-storm drawdown would be similar to Alternative 7, except for operations related to other than named events. For those events, the SFWMD would monitor antecedent conditions, groundwater levels and rainfall. If these conditions indicated a strong likelihood of flooding, SFWMD would make a recommendation to the Corps to initiate pre-storm drawdown or otherwise alter system-wide operations from those contained in the Table 2.11.

The Chairman of the Miccosukee Tribe of Indians of South Florida or his designated representatives, would monitor the conditions in WCA3A and other tribal lands and predicted rainfall. If the Tribe determines these conditions indicate jeopardy to the health or safety of the Tribe, the Chairman would make a recommendation to the Corps to change the operations of the S-12 structures or other parts of the system. The Corps would review the data, advise appropriate agencies of the conditions, and the District Commander would personally consult with the Chairman prior to making a decision whether to implement changes to the S-12 operations.

It is recognized that new technical information may be developed as this plan is implemented and that observed results may differ from predicted results. Considering this, it may be necessary to adjust operations to address the new information or observed results to achieve better performance for environmental restoration and protection, to ensure the health, safety, and well being of the general public.

2.3 Selection of Recommended Alternative

The currently recommended alternative (Alternative 7R) was selected during the collaborative conflict resolution process by the Corps, SFWMD, USFWS, and ENP based on its ability to satisfy the project purpose to the greatest degree while providing flexibility in reducing other potential impacts to the human environment. As the NEPA process proceeds, the Corps welcomes comments from all interested parties prior to finalizing the selection process.

2.4 Comparison of Alternatives

The alternatives are compared in Section 4.0, “Environmental Consequences” of this document. Figures 6, 7, and 8 show the important operational differences between the No Action Alternative (ISOP 2001), Alternative 7, and Alternative 7R (the recommended plan).

Figure 4. Proposed S-332B Seepage Reservoir

Figure 5. Alternative 7R Features

Figure 6. Alternative 1 (ISOP 2001)

Figure 7. Alternative 7B

Figure 8. Alternative 7R

Figure 9. Water Conservation Area 3A Interim Regulation Schedule

Table 2.1. Description of 95Base Simulation

	95Base Modified 2 (Test 7 Phase I)
Regulation Schedule	C&SF regulation schedules prior to ISOP.
S-343 A/B and S-344	Per the above WCA 3A regulation schedule.
S-12 A/B/C/D	Operated according to current regulation schedule, which includes rainfall plan target. Split 10/20/30/40 percent west to east.
S-333: G-3273 < 6.8'	S-333 open to deliver 55% of Shark Slough target flows as per rainfall plan target (rainfall formula + WCA 3A regulatory discharge).
S-333: G-3273 > 6.8'	S-333 closed
L-29 constraint	8.0 ft
S-355A&B	Regulatory releases are constrained by L-29 and G-3273 triggers. Dry Wet Open 8.50 8.50 Close 6.50 6.50
S-337	Water supply only
S-151	Per the above WCA 3A regulation schedule.
S-334	Closed
S-332B	Non-existent
S-332B Seepage Reservoir	Non-existent
S-332D	Non-existent
S-332	Operated according to Taylor Slough Rainfall plan with 465 cfs capacity, subject to 165 cfs limitations from Mar 1 to Jul 15.
S-175	Dry Wet Open 4.7 4.7 Close 4.3 4.3
S-194	 Dry Wet Open 5.3 5.3 Close 4.8 4.8
S-196	 Dry Wet Open 5.3 5.3 Close 4.8 4.8
S-176	Dry Wet Open 5.00 5.00 Close 4.75 4.75
S-18C	Dry Wet Open 2.6 2.6 Close 2.3 2.3

Notes:

1. South Florida Water Management Model (SFWMM) version 3.8 was used in continuous simulation mode (31 year simulation using 1965 to 1995 climatic data set) to simulate 95Base Modified 2.

2. No changes to operational criteria of 95Base Modified 2 (includes Test7 Phase I criteria) for structures not listed in the table above.

Table 2.2. Descriptions of Reasonable and Prudent Alternatives

	RPA 00	RPA 01	RPA 02
Regulation Schedule	Deviation schedule for WCA 3A as specified by USACE including raising Zone D to Zone C from Nov 1 to Feb 11. No deviation in WCA 2A regulation schedule.	Deviation schedule for WCA 3A as specified by USACE including raising Zone D to Zone C from Nov 1 to Feb 11. No deviation in WCA 2A regulation schedule.	Deviation schedule for WCA 3A as specified by USACE including raising Zone D to Zone C from Nov 1 to Feb 11. No deviation in WCA 2A regulation schedule.
S-343 A/B and S-344	Closed Nov 1 to July 15 independent of WCA 3A levels.	Closed Nov 1 to July 15 independent of WCA 3A levels.	Closed Nov 1 to July 15 independent of WCA 3A levels.
S-12 A/B/C/D	S-12A closed Nov 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12 C closed Feb 1 to Jul 15; S-12D operated normally according to WCA 3A schedule. For the remainder of the year, S-12A, B, and C followed the same schedule.	S-12A closed Nov 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12 C closed Feb 1 to Jul 15; S-12D operated normally according to WCA 3A schedule. For the remainder of the year, S-12A, B, and C followed the same schedule.	S-12A closed Nov 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12 C closed Feb 1 to Jul 15; S-12D operated normally according to WCA 3A schedule. For the remainder of the year, S-12A, B, and C followed the same schedule.
S-333: G-3273 < 6.8'	55% of the rainfall plan target to NESRS, plus as much of the remaining 45% that the S-12s can't discharge to be passed through S-334; and subject to capacity constraints, which are 1350 cfs at S-333, L-29 maximum stage limit, and canal stage limits downstream of S-334.	55% of the rainfall plan target to NESRS, plus as much of the remaining 45% that the S-12s can't discharge to be passed through S-334; and subject to capacity constraints, which are 1350 cfs at S-333, L-29 maximum stage limit, and canal stage limits downstream of S-334.	55% of the rainfall plan target to NESRS, plus as much of the remaining 45% that the S-12s can't discharge to be passed through S-334; and subject to capacity constraints, which are 1350 cfs at S-333, L-29 maximum stage limit, and canal stage limits downstream of S-334.
S-333: G-3273 > 6.8'	Pass 30% of regulatory discharge through S-333 subject to S-333 design capacity (1350 cfs)	Pass 45% of regulatory discharge through S-333 subject to S-333 design capacity (1350 cfs)	Pass 60% of regulatory discharge through S-333 subject to S-333 design capacity (1350 cfs)
L-29 constraint	9.0 ft	9.0 ft	9.0 ft
S-355A&B	Regulatory releases are constrained by L-29 and G-3273 triggers. Dry Wet Open 8.50 8.50 Close 6.50 6.50	Regulatory releases are constrained by L-29 and G-3273 triggers. Dry Wet Open 8.50 8.50 Close 6.50 6.50	Regulatory releases are constrained by L-29 and G-3273 triggers. Dry Wet Open 8.50 8.50 Close 6.50 6.50
S-337	Water supply only	Water supply only	Water supply only
S-151	Per the above WCA 3A regulation schedule.	Per the above WCA 3A regulation schedule.	Per the above WCA 3A regulation schedule.
S-334	Water supply only	Water supply only	Water supply only
S-332D	Pumped up to 500 cfs design capacity from Aug 1 to Jan 31 and to 165 cfs from Feb 1 to Jul 31. Dry Wet On 5.00 5.00 Off 4.80 4.80	Pumped up to 500 cfs design capacity from Aug 1 to Jan 31 and to 165 cfs from Feb 1 to Jul 31. Dry Wet On 5.00 5.00 Off 4.80 4.80	Pumped up to 500 cfs design capacity from Aug 1 to Jan 31 and to 165 cfs from Feb 1 to Jul 31. Dry Wet On 5.00 5.00 Off 4.80 4.80
S-332	Closed	Closed	Closed
S-175	Closed	Closed	Closed
S-194	Dry Wet	Dry Wet	Dry Wet

	Open 5.3 5.3 Close 4.8 4.8	Open 5.3 5.3 Close 4.8 4.8	Open 5.3 5.3 Close 4.8 4.8
S-196	Dry Wet Open 5.5 5.5 Close 4.8 4.8	Dry Wet Open 5.5 5.5 Close 4.8 4.8	Dry Wet Open 5.5 5.5 Close 4.8 4.8
S-176	Dry Wet Open 5.2 5.2 Close 5.0 5.0	Dry Wet Open 5.2 5.2 Close 5.0 5.0	Dry Wet Open 5.2 5.2 Close 5.0 5.0
S-18C	Dry Wet Open 2.6 2.6 Close 2.3 2.3	Dry Wet Open 2.6 2.6 Close 2.3 2.3	Dry Wet Open 2.6 2.6 Close 2.3 2.3

Table 2.3. Description of ISOP 2000

	ISOP-9d (ISOP 2000)
Regulation Schedule	Deviation schedules for WCA 2A (S-11 A,B,C structures closed) and WCA 3A as specified by USACE.
S-343 A/B and S-344	Closed Jan 1 to July 15 independent of WCA 3A levels.
S-12 A/B/C/D	S-12A closed Dec 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12 C,D closed Feb 1 to Jul 15; Follow WCA 3A regulation schedule as in 95 Base for remainder of year
S-333: G-3273 < 6.8'	Maximum possible discharge subject to S-333 design capacity (1350 cfs) and limited to sum of NESRS rainfall plan targets plus outflow through S-334.
S-333: G-3273 > 6.8'	Maximum possible discharge subject to S-333 design capacity (1350 cfs) and limited to outflow through S-334
L-29 constraint	9.0 ft
S-355A&B	Not modeled
S-337	Regulatory releases as per WCA 3A deviation schedule
S-151	Per the above WCA 3A regulation schedule.
S-334	Passes S-333 regulatory release to SDCS
S-332B	Pumped up to 325 cfs. Dry Wet On 4.70 4.70 Off 4.20 4.20
S-332B Seepage Reservoir	Not modeled
S-332D	Pumped up to 500 cfs from Jul 16 to Nov 31; 325 cfs from Dec 1 to Jan 31; and 165 cfs from Feb 1 to July 15. Dry Wet On 5.00 4.50 Off 4.80 4.00
S-332	Closed
S-175	Closed
S-194	Operated to maximize flood control discharges to coast Dry Wet Open 4.70 4.70 Close 4.20 4.20
S-196	Operated to maximize flood control discharges to coast. Dry Wet Open 4.70 4.70 Close 4.20 4.20
S-176	Dry Wet Open 4.70 4.70 Close 4.50 4.50
S-18C	Dry Wet Open 2.25 2.25 Close 2.00 2.00

Table 2.4. Description of Alternative 1 - ISOP 2001

	ISOP-9dR (ISOP 2001)
Regulation Schedule	Deviation schedule for WCA 3A as specified by USACE including raising Zone D to Zone C from Nov 1 to Feb 11. No deviation in WCA 2A regulation schedule.
S-343 A/B and S-344	Closed Nov 1 to July 15 independent of WCA 3A levels.
S-12 A/B/C/D	S-12A closed Nov 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12 C closed Feb 1 to Jul 15; S-12D was operated normally according to WCA 3A schedule. For the remainder of the year, S-12A, B, and C followed the same regulation schedule.
S-333: G-3273 < 6.8'	55% of the rainfall plan target to NESRS, plus as much of the remaining 45% that the S-12s can't discharge to be passed through S-334; and subject to capacity constraints, which are 1350 cfs at S-333, L-29 maximum stage limit, and canal stage limits downstream of S-334.
S-333: G-3273 > 6.8'	No discharge to NESRS; release 55% of the rainfall plan target, plus as much of the remaining 45% that the S-12s can't discharge through S-333 and S-334, subject to capacity constraints.
L-29 constraint	9.0 ft
S-355A&B	Not modeled
S-337	Regulatory releases as per WCA 3A deviation schedule.
S-151	Per the above WCA 3A regulation schedule.
S-334	Same as in 95Base except that it also may pass all or part of S-333 releases to the SDCS, depending on stage at G-3273.
S-332B	Pumped up to 325 cfs from Jun through Jan; and 125 cfs from Feb through May. Dry Wet On 4.70 4.70 Off 4.20 4.20
S-332B Seepage Reservoir	160 acres with emergency overflow
S-332D	Pumped up to 500 cfs from Jul 16 to Nov 31; 325 cfs from Dec 1 to Jan 31; and 165 cfs from Feb 1 to July 15. Dry Wet On 5.00 4.50 Off 4.80 4.00
S-332	Closed
S-175	Closed
S-194	Operated to maximize flood control discharges to coast Dry Wet Open 4.70 4.70 Close 4.20 4.20
S-196	Operated to maximize flood control discharges to coast. Dry Wet Open 4.70 4.70 Close 4.20 4.20
S-176	Dry Wet Open 4.70 4.70 Close 4.50 4.50
S-18C	Dry Wet Open 2.25 2.25 Close 2.00 2.00

Table 2.5 Description of Alternative 2.

	Alternative 2	
Treatment	**Phase 1**	**Phase 2**
	IOP 2b	**IOP 2**
Regulation Schedule	Deviation schedules for WCA 2A (S-11 A,B,C structures closed) and 3A as specified by USACE.	Deviation schedules for WCA 2A (S-11 A,B,C structures closed) and 3A as specified by USACE.
S-343 A/B **S-344**	Closed Jan 1 to July 15 independent of WCA 3A levels.	Closed Jan 1 to July 15 independent of WCA 3A levels.
S-12 A/B/C/D	S-12A closed Dec 1 - Jul 15; S-12B closed Jan 1 - Jul 15; S-12 C,D closed Feb 1 - Jul 15; Follow WCA 3A regulation schedule as in 95 Base for remainder of year	S-12A closed Dec 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12 C,D close Feb 1 to Jul 15; Follow WCA 3A regulation schedule as in 95 Base for remainder of year
S-333: **G-3273 < 6.8'**	55% of the rainfall plan target to NESRS, plus as much of the remaining 45% that the S-12s can't discharge to be passed through S-334; and subject to capacity constraints, which are 1350 cfs at S-333, L-29 maximum stage limit, and canal stage limits downstream of S-334.	S-333 open to deliver 55% of Shark Slough target flows as per rainfall plan target (rainfall formula + WCA 3A regulatory discharge).
S-333: **G-3273 > 6.8'**	No discharge to NESRS; release 55% of the rainfall plan target, plus as much of the remaining 45% that the S-12s can't discharge through S-333 and S-334, subject to capacity constraints.	Maximum possible discharge subject to S-333 design capacity (1350 cfs) with G3273 trigger removed.
L-29 constraint	9.0 ft	9.0 ft
S-337	Regulatory releases as per WCA 3A deviation schedule	Regulatory releases as per WCA 3A deviation schedule
S-151	Regulatory releases as per WCA 3A deviation schedule	Regulatory releases as per WCA 3A deviation schedule
S-334	Passes S-333 regulatory release to SDCS	Closed
S-332B	Pumped up to 375 cfs On at 4.7, Off at 4.2	Pumped up to 325 cfs; On at 4.5, Off at 4.0
S-332B Seepage Reservoir	160 acres with emergency overflow.	160 acres with emergency overflow.
S-332D	Pumped up to 500 cfs design capacity from Aug 1 to Nov 30; 325 cfs from Dec 1 to Dec 31; 165 cfs from Jan 1 to Jul 31. Dry-On at 5.0, Off at 4.8; Wet-On at 4.5, Off at 4.0.	Pumped up to 500 cfs design capacity from Aug 1 to Nov 30; 325 cfs from Dec 1 to Jan 31; 165 cfs from Feb 1 to Jul 31. Dry-On at 5.0, Off at 4.8; Wet-On at 4.5, Off at 4.0.
S-332	Closed	Closed
S-175	Closed	Closed
S-194 **S-196**	Operated to maximize flood control discharges to coast; Dry- Open at 4.7, Close at 4.2; Wet- Open at 4.7, Close at 4.2.	Operated to maximize flood control discharges to coast; Dry- Open at 4.7, Close at 4.2; Wet- Open at 4.7, Close at 4.2.
S-176	Dry-Open at 4.7, Close at 4.5; Wet-Open at 4.7, Close at 4.5.	Dry-Open at 5.0, Close at 4.75; Wet-Open at 5.0, Close at 4.75.
S-18C	Dry-Open at 2.25, Close at 2.0; Wet-Open at 2.25, Close at 2.0.	Dry-Open at 2.25, Close at 2.0; Wet-Open at 2.25, Close at 2.0.

Table 2.6 Description of Alternative 3.

	Alternative 3	
Treatment	**Phase 1**	**Phase 2**
	IOP 2a	**IOP 2**
Regulation Schedule	Deviation schedules for WCA 2A (S-11 A,B,C structures closed) and 3A as specified by USACE.	Deviation schedules for WCA 2A (S-11 A,B,C structures closed) and 3A as specified by USACE.
S-343 A/B **S-344**	Closed Jan 1 to July 15 independent of WCA 3A levels.	Closed Jan 1 to July 15 independent of WCA 3A levels..
S-12 A/B/C/D	S-12A closed Dec 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12 C,D close Feb 1 to Jul 15; Follow WCA 3A regulation schedule as in 95 Base for remainder of year	S-12A closed Dec 1 - Jul 15; S-12B closed Jan 1 - Jul 15; S-12 C,D closed Feb 1 - Jul 15; Follow WCA 3A regulation schedule as in 95 Base for remainder of year
S-333: **G-3273 < 6.8'**	S-333 open to deliver 55% of Shark Slough target flows as per rainfall plan target (rainfall formula + WCA 3A regulatory discharge).	S-333 open to deliver 55% of Shark Slough target flows as per rainfall plan target (rainfall formula + WCA 3A regulatory discharge).
S-333: **G-3273 > 6.8'**	S-333 closed	Maximum possible discharge subject to S-333 design capacity (1350 cfs) with G3273 trigger removed.
L-29 constraint	9.0 ft	9.0 ft
S-337	Regulatory releases as per WCA 3A deviation schedule	Regulatory releases as per WCA 3A deviation schedule
S-151	Regulatory releases as per WCA 3A deviation schedule	Regulatory releases as per WCA 3A deviation schedule
S-334	Closed	Closed
S-332B	Pumped up to 325 cfs; On at 4.5, Off at 4.0.	Pumped up to 325 cfs; On at 4.5, Off at 4.0.
S-332B Seepage Reservoir	160 acres with emergency overflow.	160 acres with emergency overflow.
S-332D	Pumped up to 500 cfs design capacity from Aug 1 to Nov 30; 325 cfs from Dec 1 to Jan 31; 165 cfs from Feb 1 to Jul 31. Dry-On at 5.0, Off at 4.8; Wet-On at 4.5, Off at 4.0.	Pumped up to 500 cfs design capacity from Aug 1 to Nov 30; 325 cfs from Dec 1 to Jan 31; 165 cfs from Feb 1 to Jul 31. Dry-On at 5.0, Off at 4.8; Wet-On at 4.5, Off at 4.0.
S-332	Closed	Closed
S-175	Closed	Closed
S-194 **S-196**	Operated to maximize flood control discharges to coast; Dry- Open at 4.7, Close at 4.2; Wet-Open at 4.7, Close at 4.2.	Operated to maximize flood control discharges to coast; Dry- Open at 4.7, Close at 4.2; Wet-Open at 4.7, Close at 4.2.
S-176	Dry-Open at 5.0, Close at 4.75; Wet-Open at 5.0, Close at 4.75.	Dry-Open at 5.0, Close at 4.75; Wet-Open at 5.0, Close at 4.75.
S-18C	Dry-Open at 2.25, Close at 2.0; Wet-Open at 2.25, Close at 2.20.	Dry-Open at 2.25, Close at 2.0; Wet-Open at 2.25, Close at 2.20.

Table 2.7 Description of Alternative 4.

	Alternative 4	
Treatment	**Phase 1**	**Phase 2**
	IOP 3a	**IOP 3**
Regulation Schedule	Deviation schedules for WCA 1, 2A and 3A as specified by USACE.	Deviation schedules for WCA 1, 2A and 3A as specified by USACE.
S-343 A/B **S-344**	Closed Nov 1 to July 15 independent of WCA 3A levels.	Closed Nov 1 to July 15 independent of WCA 3A levels..
S-12 A/B/C/D	S-12A, B, C and D closed Nov 1 to Jul 15; Follow WCA 3A regulation schedule as in 95 Base for remainder of year	S-12A, B, C and D closed Nov 1 to Jul 15; Follow WCA 3A regulation schedule as in 95 Base for remainder of year
S-333: **G-3273 < 6.8'**	S-333 open to deliver 55% of Shark Slough target flows as per rainfall plan target (rainfall formula + WCA 3A regulatory discharge).	S-333 open to deliver 55% of Shark Slough target flows as per rainfall plan target (rainfall formula + WCA 3A regulatory discharge).
S-333: **G-3273 > 6.8'**	S-333 closed	Maximum possible discharge subject to S-333 design capacity (1350 cfs) with G3273 trigger removed.
L-29 constraint	9.0 ft	9.0 ft
S-337	Regulatory releases as per WCA 3A deviation schedule	Regulatory releases as per WCA 3A deviation schedule
S-151	Regulatory releases as per WCA 3A deviation schedule	Regulatory releases as per WCA 3A deviation schedule
S-334	Closed	Closed
S-332B	Pumped up to 325 cfs; Dry-On at 4.5, Off at 4.0; Wet-On at 4.5, Off at 4.0.	Pumped up to 325 cfs; Dry-On at 4.5, Off at 4.0; Wet-On at 4.5, Off at 4.0.
S-332B Seepage Reservoir	160 acres with emergency overflow.	160 acres with emergency overflow.
S-332D	Pumped up to 500 cfs design capacity from Aug 1 to Nov 30; 325 cfs from Dec 1 to Jan 31 31; 165 cfs from Feb 1 to Jul 31. Dry-On at 5.0, Off at 4.8; Wet-On at 4.5, Off at 4.0.	Pumped up to 500 cfs design capacity from Aug 1 to Nov 30; 325 cfs from Dec 1 to Jan 31; 165 cfs from Feb 1 to Jul 31. Dry-On at 5.0, Off at 4.8; Wet-On at 4.5, Off at 4.0.
S-332	Closed	Closed
S-175	Closed	Closed
S-194 **S-196**	Operated to maximize flood control discharges to coast; Dry-Open at 4.7, Close at 4.2; Wet-Open at 4.7, Close at 4.2.	Operated to maximize flood control discharges to coast; Dry-Open at 4.7, Close at 4.2; Wet-Open at 4.7, Close at 4.2.
S-176	Dry-Open at 5.0, Close at 4.75; Wet-Open at 5.0, Close at 4.75.	Dry-Open at 5.0, Close at 4.75; Wet-Open at 5.0, Close at 4.75.
S-18C	Dry-Open at 2.25, Close at 2.0; Wet-Open at 2.25, Close at 2.0.	Dry-Open at 2.25, Close at 2.0; Wet-Open at 2.25, Close at 2.0.

Table 2.8 Description of Alternative 5.

	Alternative 5	
Treatment	**Phase 1**	**Phase 2**
	IOP 4a (ISOP 9dR1)	**IOP 4 (ISOP 9dR2)**
Regulation Schedule	No deviation schedules for WCA 2A. Deviation schedule for WCA 3A as specified by USACE including raising Zone D to Zone C from Nov 1 to Feb. 11.	No deviation schedules for WCA 2A. Deviation schedule for WCA 3A as specified by USACE including raising Zone D to Zone C from Nov 1 to Feb. 11.
S-343 A/B **S-344**	Closed Nov 1 to July 15 independent of WCA 3A levels..	Closed Nov 1 to July 15 independent of WCA 3A levels..
S-12 A/B/C/D	S-12A closed Nov 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12 C,D close Feb 1 to Jul 15; Follow WCA 3A regulation schedule as in 95 Base for remainder of year	S-12A closed Nov 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12 C,D close Feb 1 to Jul 15; Follow WCA 3A regulation schedule as in 95 Base for remainder of year
S-333: **G-3273 < 6.8'**	55% of the rainfall plan target to NESRS, plus as much of the remaining 45% that the S-12s can't discharge to be passed through S-334; and subject to capacity constraints, which are 1350 cfs at S-333, L-29 maximum stage limit, and canal stage limits downstream of S-334.	55% of the rainfall plan target to NESRS, plus as much of the remaining 45% that the S-12s can't discharge to be passed through S-334; and subject to capacity constraints, which are 1350 cfs at S-333, L-29 maximum stage limit, and canal stage limits downstream of S-334.
S-333: **G-3273 > 6.8'**	No discharge to NESRS; release 55% of the rainfall plan target, plus as much of the remaining 45% that the S-12s can't discharge through S-333 and S-334, subject to capacity constraints.	Maximum possible discharge subject to S-333 design capacity (1350 cfs) with G3273 trigger removed.
L-29 constraint	9.0 ft	9.0 ft
S-337	Regulatory releases as per WCA 3A deviation schedule	Regulatory releases as per WCA 3A deviation schedule
S-151	Regulatory releases as per WCA 3A deviation schedule	Regulatory releases as per WCA 3A deviation schedule
S-334	Same as 95Base except that it also may pass all or part of S-333 releases to the SDCS, depending on stage at G-3273.	Closed
S-332B	Pumped up to 500 cfs from Aug-Jan; 325 cfs in Feb, Jun, and July; and 125 cfs Mar-May; Dry-On at 5.0, Off at 4.3; Wet-On at 4.7, Off at 4.0.	Pumped up to 500 cfs from Aug-Jan; 325 cfs in Feb, Jun, and July; and 125 cfs Mar-May; Dry-On at 5.0, Off at 4.3; Wet-On at 4.7, Off at 4.0.
S-332B Seepage Reservoir	160 acres with emergency overflow.	160 acres with emergency overflow.
S-332D	Pumped up to 500 cfs design capacity from July 16 to Nov 30; 325 cfs Dec 1 to Jan 31; 165 cfs from Feb 1 to Jul 15. Dry-On at 5.0, Off at 4.8; Wet-On at 4.7, Off at 4.2.	Pumped up to 500 cfs design capacity from July 16 to Nov 30; 325 cfs Dec 1 to Jan 31; 165 cfs from Feb 1 to Jul 15. Dry-On at 5.0, Off at 4.8; Wet-On at 4.7, Off at 4.2.
S-332	Closed	Closed
S-175	Closed	Closed
S-194 **S-196**	Operated to maximize flood control discharges to coast; Dry-Open at 4.7, Close at 4.2; Wet-Open at 4.7, Close at 4.2.	Operated to maximize flood control discharges to coast; Dry-Open at 4.7, Close at 4.2; Wet-Open at 4.7, Close at 4.2.
S-176	Dry-Open at 4.85, Close at 4.65; Wet-Open at 4.8, Close at 4.7.	Dry-Open at 4.85, Close at 4.65; Wet-Open at 4.8, Close at 4.7.
S-18C	Dry-Open at 2.25, Close at 2.0; Wet-Open at 2.25, Close at 2.0.	Dry-Open at 2.25, Close at 2.0; Wet-Open at 2.25, Close at 2.0.

Table 2.9 Description of Alternative 6.

	Alternative 6
Regulation Schedule	Deviation schedule for WCA 3A as specified by USACE including raising Zone D to Zone C from Nov 1 to Feb 11. No deviation in WCA 2A regulation schedule.
S-343 A/B and S-344	Closed Nov 1 to July 15 independent of WCA 3A levels.
S-12 A/B/C/D	S-12A closed Nov 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12C closed Feb 1 to Jul 15; S-12D operated according to WCA 3A regulation schedule. Follow WCA 3A regulation schedule after Jul 15.
S-333: G-3273 < 6.8'	55% of the rainfall plan target to NESRS, plus as much of the remaining 45% that the S-12s can't discharge to be passed through S-334; and subject to capacity constraints, which are 1350 cfs at S-333, L-29 maximum stage limit, and canal stage limits downstream of S-334.
S-333: G-3273 > 6.8'	No discharge to NESRS; release 55% of the rainfall plan target, plus as much of the remaining 45% that the S-12s can't discharge through S-333 and S-334, subject to capacity constraints.
L-29 constraint	9.0 ft
S-355A&B	Dry Wet Open 8.50 8.50 Close 6.50 6.50
S-337	Regulatory releases as per WCA 3A deviation schedule.
S-151	Regulatory releases as per WCA 3A deviation schedule.
S-334	Same as in 95Base except that it also may pass all or part of S-333 releases to the SDCS, depending on stage at G-3273.
S-332B	Pumped up to **250 cfs from Jun through Feb**; and 125 cfs from Mar through May. Dry Wet On 5.00 4.70 Off 4.30 4.00
S-332B Seepage Reservoir	400 acres with minimum overflow (if any)
S-332D	Pumped up to 500 cfs from Jul 16 to Nov 31; 325 cfs from Dec 1 to Jan 31; and 165 cfs from Feb 1 to Jul 15. Dry Wet On 5.00 4.70 Off 4.80 4.20
S-332	Closed
S-175	Closed
S-194	Operated to maximize flood control discharges to coast Dry Wet Open 4.70 4.70 Close 4.20 4.20
S-196	Operated to maximize flood control discharges to coast. Dry Wet Open 4.70 4.70 Close 4.20 4.20
S-176	Dry Wet Open 4.85 4.80 Close 4.65 4.70
S-18C	Dry Wet Open 2.25 2.25 Close 2.00 2.00

Table 2.10 Description of Alternative 7.

	Alternative 7a	Alternative 7b
	No WCA 3A Regulatory Releases to SDCS or Shark Slough	**WCA 3A Regulatory Releases to SDCS**
Regulation Schedule	Deviation schedule for WCA 3A as specified by USACE including raising Zone D to Zone C from Nov 1 to Feb 11. No deviation in WCA 2A regulation schedule.	Deviation schedule for WCA 3A as specified by USACE including raising Zone D to Zone C from Nov 1 to Feb 11. No deviation in WCA 2A regulation schedule.
S-343 A/B and S-344	Closed Nov 1 to July 15 independent of WCA 3A levels.	Closed Nov 1 to July 15 independent of WCA 3A levels.
S-12 A/B/C/D	S-12A closed Nov 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12C closed Feb 1 to Jul 15; S-12D no closure dates. Follow WCA 3A regulation schedule after Jul 15. Note: If closure requires regulatory releases to SDCS then switch to operations for regulatory releases to SDCS.	S-12A closed Nov 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12C closed Feb 1 to Jul 15; S-12D no closure dates. Follow WCA 3A regulation schedule after Jul 15.
S-333: G-3273 < 6.8' NGVD Degrade the lower four miles of the L-67 extension	55% of the rainfall plan target to NESRS and 45% through the S-12 structures	55% of the rainfall plan target to NESRS, plus as much of the remaining 45% that the S-12s can't discharge to be passed through S-334; and subject to capacity constraints, which are 1350 cfs at S-333, L-29 maximum stage limit, and canal stage limits downstream of S-334.
S-333: G-3273 > 6.8' NGVD	Closed	Match S-333 with S-334 flows
L-29 constraint	9.0 ft	9.0 ft
S-355A&B	Follow the same constraints as S-333. Open whenever gradient allows southerly flow.	Follow the same constraints as S-333. Open whenever gradient allows southerly flow.
S-337	Water Supply	Regulatory releases as per WCA 3A deviation schedule.
S-151	Water Supply	Regulatory releases as per WCA 3A deviation schedule.
S-335	Water Supply Allow releases through S-335 if there is downstream capacity consistent with pre-ISOP operations. "Downstream capacity" would not include capacity created by pumping at S-332B or S-332D and not trigger opening S-18C at 2.6. Note: It is recognized that under	When making regulatory releases through S-151, match S-335 outflows with inflows from S-151 and S-337 Use S-333/334 before S-335

	these conditions operations of S-335 would be infrequent.	
S-334	Closed	Pass all or partial S-333 flows Depending on stage at G-3273
S-338	Open 5.8 Close 5.5	Open 5.8 Close 5.4
G-211	Open 6.0 Close 5.5	Open 5.7 Close 5.3
S-331	Angel's Criteria	Angel's Criteria
S-332B Note 1: There would be two 125-cfs pumps and one 75-cfs pump directed to the second detention basin. The remaining two 125-cfs pumps would be directed to the first detention basin. If possible, the 75-cfs pump would be designed so that it can be directed to either basin. Note 2: A new indicator would be established for Subpopulation F and a new gauge would be installed about ½ mile west of the weir on the western edge of the retention area. Pumping would cease after 180 days of above ground hydroperiod at the new gauge during a year that runs from July 15th to July 14th. After water levels recede below ground, pumping can be resumed at a rate that maintains water elevations below ground at the gauge until the beginning of the next year.	Pumped up to 250 cfs* from Jun through Feb; and 125 cfs from Mar through May. On 5.0 Off 4.7** *This pumping rate is based on the assumption that there would be no overflow into the Park. If there is overflow into the Park, the pumping rate would be adjusted. **If, after the first 30 days of operation, there is no observed drawdown at the pump, this stage level would be raised to 4.8	Pumped up to 250 cfs* from Jun through Feb; and 125 cfs from Mar through May. On 4.8 Off 4.5 *This pumping rate is based on the assumption that there would be no overflow into the Park. If there is overflow into the Park, the pumping rate would be adjusted to eliminate overflow.
S-332B Seepage Reservoir	400 acres with no overflow to the west	400 acres with no overflow to the west
S-332D	Pumped up to 500 cfs from Jul 16 (or the end of the breeding season, as confirmed by FWS) to Nov 31; 325 cfs from Dec 1 to Jan 31; and 165 cfs* from Feb 1 to Jul 15. Meet Taylor Slough Rainfall formula (No L-31W constraint) On 4.85 Off 4.65 *New information would be sought to evaluate the feasibility of	Pumped up to 500 cfs from Jul 16 (or the end of the breeding season, as confirmed by FWS) to Nov 31; 325 cfs from Dec 1 to Jan 31; and 165 cfs* from Feb 1 to Jul 15. Meet Taylor Slough Rainfall formula (No L-31W constraint) On 4.7 Off 4.5 *New information would be sought to evaluate the feasibility of

	modifying the 165 cfs constraint	modifying the 165 cfs constraint
S-332	Closed	Closed
S-175	Closed	Closed
S-194	Open 5.5 Close 4.8	Operated to maximize flood control discharges to coast Open 4.9 Close 4.5
S-196	Open 5.5 Close 4.8	Operated to maximize flood control discharges to coast Open 4.9 Close 4.5
S-176	Open 5.0 Close 4.75	Open 4.9 Close 4.7
S-177	Open 4.2 (see S-197 open) Close 3.6	Open 4.2 (see S-197 open) Close 3.6
S-18C	Open 2.6 Close 2.3	Open 2.25 Close 2.00
S-197	If S-177 headwater is greater than 4.1 or S-18C headwater is greater than 2.8 open 3 culverts If S-177 headwater is greater than 4.2 for 24 hours or S-18C headwater is greater than 3.1 open 7 culverts If S-177 headwater is greater than 4.3 or S-18C headwater is greater than 3.3 open 13 culverts Close gates when all the following conditions are met: 4. S-176 headwater is less than 5.2 and S-177 headwater is less than 4.2 5. Storm has moved away from the basin 6. After Conditions 1 and 2 are met, keep the number of S-197 culverts open necessary only to match residual flow through S-176. All culverts should be closed if S-177 headwater is less than 4.1 after all conditions are satisfied.	If S-177 headwater is greater than 4.1 or S-18C headwater is greater than 2.8 open 3 culverts If S-177 headwater is greater than 4.2 for 24 hours or S-18C headwater is greater than 3.1 open 7 culverts If S-177 headwater is greater than 4.3 or S-18C headwater is greater than 3.3 open 13 culverts Close gates when all the following conditions are met: 4. S-176 headwater is less than 5.2 and S-177 headwater is less than 4.2 5. Storm has moved away from the basin 6. After Conditions 1 and 2 are met, keep the number of S-197 culverts open necessary only to match residual flow through S-176. All culverts should be closed if S-177 headwater is less than 4.1 after all conditions are satisfied.

Table 2.11 Description of Alternative 7R.

	No WCA-3A Regulatory Releases to SDCS or Shark Slough	WCA-3A Regulatory Releases to SDCS
Regulation Schedule	Deviation schedule for WCA-3A (Figure 9), November 2000 WCA-3A interim regulation schedule) as specified by USACE including raising Zone D to Zone C from Nov 1 to Feb 11. No deviation in WCA-2A regulation schedule.	Deviation schedule for WCA-3A (Figure 9), November 2000 WCA-3A interim regulation schedule) as specified by USACE including raising Zone D to Zone C from Nov 1 to Feb 11. No deviation in WCA-2A regulation schedule.
S-343 A/B and S-344	Closed Nov 1 to July 15 independent of WCA-3A levels.	Closed Nov 1 to July 15 independent of WCA-3A levels.
S-12 A/B/C/D Sandbag culverts under Tram Road by 1 February if necessary.	S-12A closed Nov 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12C closed Feb 1 to Jul 15; S-12D no closure dates. Follow WCA 3A regulation schedule after Jul 15. Note: If closure requires regulatory releases to SDCS then switch to operations for regulatory releases to SDCS.	S-12A closed Nov 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12C closed Feb 1 to Jul 15; S-12D no closure dates. Follow WCA 3A regulation schedule after Jul 15.
S-333: G-3273 < 6.8' NGVD Degrade the lower four miles of the L-67 extension	55% of the rainfall plan target to NESRS and 45% through the S-12 structures When WCA-3A is in Zone E1 or above, maximum practicable through S-333 to NESRS per WCA-3A deviation schedule.	55% of the rainfall plan target to NESRS, plus as much of the remaining 45% that the S-12s can't discharge to be passed through S-334; and subject to capacity constraints, which are 1350 cfs at S-333, L-29 maximum stage limit, and canal stage limits downstream of S-334. When WCA-3A is in Zone E1 or above, maximum practicable through S-333 to NESRS per WCA-3A deviation schedule.
S-333: G-3273 > 6.8' NGVD	Closed	Match S-333 with S-334 flows
L-29 constraint	9.0 ft	9.0 ft
S-355A&B	Follow the same constraints as S-333. Open whenever gradient allows southerly flow.	Follow the same constraints as S-333. Open whenever gradient allows southerly flow.
S-337	Water Supply	Regulatory releases as per WCA-3A deviation schedule.
S-151	Water Supply	Regulatory releases as per WCA-3A deviation schedule.
S-335	Water Supply The intent is to limit the volume of water passed at S335 to pre-ISOP conditions and not use S332B, S332C, or S332D or other triggers to pass additional flows.	When making regulatory releases through S-151, limit S-335 outflows to not exceed inflows from the S-151/S-337 path Use S-333/S-334 before S-335/S-151/S-337

	Note: It is recognized that under these conditions operations of S-335 would be infrequent.	
S-334	Water Supply	Pass all or partial S-333 flows Depending on stage at G-3273
S-338	Open 5.8 Close 5.5	Open 5.8 Close 5.4
G-211 Tailwater constraint 5.3	Open 6.0 Close 5.5	Open 5.7 Close 5.3
S-331	Angel's Criteria	Angel's Criteria
S-332B Note 1: There will be two 125-cfs pumps and one 75-cfs pump directed to the west seepage reservoir. The remaining two 125-cfs pumps will be directed to the north seepage reservoir. Note 2: A new indicator will be established for Subpopulation F. Operations will be modifed as necessary to achieve desired habitat conditions consistent with the restoration purposes outlined in the C-111 GRR.	Pumped up to 575 cfs* On 5.0 Off 4.7** *Pump to capacity if limiting conditions within the Sparrow habitat are not exceeded. There will be no overflow into the Park when the project (i.e., the S-332B north seepage reservoir and the partial S-332B/S-332C connector) is complete and when it is practical to do the construction necessary to raise the western levee. There may be overflow during emergency events until the project is complete and the western levee is raised. **If, after the first 30 days of operation, there is no observed drawdown at the pump, this stage level will be raised to 4.8	Pumped up to 575 cfs* On 4.8 Off 4.5 *Pump to capacity if limiting conditions within the Sparrow habitat are not exceeded. There will be no overflow into the Park when the project (i.e., the S-332B north seepage reservoir and the partial S-332B/S-332C connector) is complete and when it is practical to do the construction necessary to raise the western levee. There may be overflow during emergency events until the project is complete and the western levee is raised.. .
S-332B North Seepage Reservoir	The north reservoir is the new 240-acre reservoir located to the north of the pump station with a weir discharging to the east. Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if the Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet when possible.	The north reservoir is the new 240-acre reservoir located to the north of the pump station with a weir discharging to the east. Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if the Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet when possible.

S-332B West Seepage Reservoir	The west reservoir is the existing 160-acre reservoir and is to the west of the pump station. There will be no overflow into the Park when the project (i.e., the S-332B north seepage reservoir and the partial S-332B/S-332C connector) is complete and when it is practical to do the construction necessary to raise the western levee. There may be overflow during emergency events until the project is complete and the western levee is raised. Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if the Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet.	The west reservoir is the existing 160-acre reservoir and is to the west of the pump station. There will be no overflow into the Park when the project (i.e., the S-332B north seepage reservoir and the partial S-332B/S-332C connector) is complete and when it is practical to do the construction necessary to raise the western levee. There may be overflow during emergency events until the project is complete and the western levee is raised. Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if the Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet.
S332C The S-332C pump capacity is temporary. A new indicator will be established and a new gauge will be installed in Rocky Glades. Operations will be modifed as necessary to achieve desired habitat conditions consistent with the restoration of Taylor Slough based on the C-111 GRR.	Pumped up to 575 cfs* On 5.00 Off 4.70** * Pump to capacity unless habitat conditions are not being achieved within the Rocky Glades. There will be no overflow into the Park. **If, after the first 30 days of operation, there is no observed drawdown at the pump, this stage level will be raised to 4.8	Pumped up to 575 cfs* On 4.8 Off 4.5 * Pump to capacity unless habitat conditions are not being achieved within the Rocky Glades. There will be no overflow into the Park.
S-332C Seepage Reservoir	300 acres with overflow to the east Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of	300 acres with overflow to the east Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of

	2.0 feet. However, if the Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet.	2.0 feet. However, if the Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet.
S-332B/S-332C Connector	141 acres partial 206 acres full 1,262 acres with the land swap Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0' The Corps, FWS, ENP, and SFWMD will jointly develop a rule for emergency operations that is consistent with C-111 project purposes before the land swap B/C connector is used.	141 acres partial 206 acres full 1,262 acres with the land swap Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0'. The Corps, FWS, ENP, and SFWMD will jointly develop a rule for emergency operations that is consistent with C-111 project purposes before the land swap B/C connector is used.
S-332D	Pumped up to 500 cfs from Jul 16 (or the end of the breeding season, as confirmed by FWS) to Nov 31; 325 cfs from Dec 1 to Jan 31; and 165 cfs* from Feb 1 to Jul 15. Meet Taylor Slough Rainfall formula consistent with marsh restoration (No L-31W constraint) On 4.85 Off 4.65 *New information will be sought to evaluate the feasibility of modifying the 165 cfs constraint	Pumped up to 500 cfs from Jul 16 (or the end of the breeding season, as confirmed by FWS) to Nov 31; 325 cfs from Dec 1 to Jan 31; and 165 cfs* from Feb 1 to Jul 15. Meet Taylor Slough Rainfall formula consistent with marsh restoration (No L-31W constraint) On 4.7 Off 4.5 *New information will be sought to evaluate the feasibility of modifying the 165 cfs constraint
Frog Pond Seepage Reservoir	810 acres with overflow into Taylor Slough Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin.	810 acres with overflow into Taylor Slough Normal operations will be targeted to achieve marsh restoration. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin.

	This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to a maximum of 4.0 feet. However, a depth of 4.0 feet in the Frog Pond is not possible at this time due to the constraint of the S-332D pump station outlet elevation.	This seepage reservoir will have a normal maximum depth of water of 2.0 feet. However, if Corps determines a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to a maximum of 4.0 feet. However, a depth of 4.0 feet in the Frog Pond is not possible at this time due to the constraint of the S-332D pump station outlet elevation.
S-332	Closed	Closed
S-175	Closed	Closed
S-194	Open 5.5 Close 4.8	Operated to maximize flood control discharges to coast Open 4.9 Close 4.5
S-196	Open 5.5 Close 4.8	Operated to maximize flood control discharges to coast Open 4.9 Close 4.5
S-176	Open 5.0 Close 4.75	Open 4.9 Close 4.7
S-177	Open 4.2 (see S-197 open) Close 3.6	Open 4.2 (see S-197 open) Close 3.6
S-18C	Open 2.6 Close 2.3	Open 2.25 Close 2.00
S-197	If S-177 headwater is greater than 4.1 or S-18C headwater is greater than 2.8 open 3 culverts If S-177 headwater is greater than 4.2 for 24 hours or S-18C headwater is greater than 3.1 open 7 culverts If S-177 headwater is greater than 4.3 or S-18C headwater is greater than 3.3 open 13 culverts Close gates when all the following conditions are met: 7. S-176 headwater is less than 5.2 and S-177 headwater is less than 4.2 8. Storm has moved away from the basin 9. After Conditions 1 and 2 are met, keep the number of S-197 culverts open necessary only to match residual flow through S-176. All culverts should be closed if S-177 headwater is less than 4.1 after all conditions are satisfied.	If S-177 headwater is greater than 4.1 or S-18C headwater is greater than 2.8 open 3 culverts If S-177 headwater is greater than 4.2 for 24 hours or S-18C headwater is greater than 3.1 open 7 culverts If S-177 headwater is greater than 4.3 or S-18C headwater is greater than 3.3 open 13 culverts Close gates when all the following conditions are met: 7. S-176 headwater is less than 5.2 and S-177 headwater is less than 4.2 8. Storm has moved away from the basin 9. After Conditions 1 and 2 are met, keep the number of S-197 culverts open necessary only to match residual flow through S-176. All culverts should be closed if S-177 headwater is less than 4.1 after all conditions are satisfied.
S-356	When conditions permit (i.e., G-3273 and L-29 constraints), discharges from S356 will go into	When conditions permit (i.e., no S-334 regulatory releases and G-3273 and L-29 constraints), discharges

	L-29. Pumping will be limited to the amount of seepage into L-31N in the reach between S-335 and G-211. A technical team will evaluate pumping limits and operations. The pumps will be operated accordingly.	from S356 will go into L-29. Pumping will be limited to the amount of seepage into L-31N in the reach between S-335 and G-211. A technical team will evaluate pumping limits and operations. The pumps will be operated accordingly.

Note: Prestorm drawdown will be the same as in the Oct 01 SDEIS with the additional language….

Operations for other than named events. SFWMD will monitor antecedent conditions, groundwater levels, canal levels and rainfall. If these conditions indicate a strong likelihood of flooding, SFWMD will make a recommendation to the Corps to initiate pre-storm operations. The Corps will review the data, advise ENP, FWS of the conditions, consult with the Miccosukee Tribe and make a decision whether to implement pre-storm drawdown or otherwise alter systemwide operations from those contained in the table.

Note: The Chairman of the Miccosukee Tribe of Indians of South Florida or his designated representatives, will monitor the conditions in WCA3A and other tribal lands and predicted rainfall. If the Tribe determines these conditions indicate jeopardy to the health or safety of the Tribe, the Chairman will make a recommendation to the Corps to change the operations of the S12 structures or other parts of the system. The Corps will review the data, advise appropriate agencies of the conditions, and the District Commander will personally consult with the Chairman prior to making a decision whether to implement changes to the S12 operations.

3.0 AFFECTED ENVIRONMENT

3.1 Climate

The subtropical climate of south Florida, with its distinct wet and dry seasons, high rate of evapotranspiration, and climatic extremes of floods, droughts, and hurricanes, represents a major physical driving force that sustains the Everglades while creating water supply and flood control issues in the agricultural and urban segments.

Seasonal rainfall patterns in south Florida resemble the wet and dry season patterns of the humid tropics more than the winter and summer patterns of temperate latitudes. Of the 53 inches of rain that south Florida receives on average annually, 75% falls during the wet season months of May through October. During the wet season, thunderstorms that result from easterly tradewinds and land-sea convection patterns occur almost daily. Wet season rainfall follows a bimodal pattern with peaks during May through June and September through October. Tropical storms and hurricanes also provide major contributions to wet season rainfall with a high level of interannual variability and low level of predictability. During the dry season, rainfall is governed by large-scale winter weather fronts that pass through the region approximately weekly. High evapotranspiration rates in south Florida roughly equal annual precipitation. Recorded annual rainfall in south Florida has varied from 37 to 106 inches, and interannual extremes in rainfall result in frequent years of flood and drought.

3.2 Geology and Soils

The geology and soils of south Florida represent many of the opportunities, constraints, and impacts of regional water management. The high transmissivity of the Biscayne Aquifer allows rapid recharge of lower east coast well fields while it sets the stage for water competition between the Everglades and Biscayne Bay regarding the issue of seepage control. The loss of peat soils of the Everglades provides an indicator of ecosystem change due to drainage activities. Peat soils predominate in previously flooded areas. Peat soils have subsided as a result of oxidation due to drainage, which has affected local topography and hydroperiods.

The lower east coast on the Atlantic Coastal Ridge is mostly underlain by thin sand and Miami Limestone that are highly permeable and moderately to well drained. To the west of the coastal ridge, soils of the lower east coast contain fine sand and loamy material and have poor drainage. Rockland areas on the coastal ridge in Dade County are characterized by weathered limestone surfaces and karst features such as solution holes and sinkholes. Higher elevation marshes of the southern Everglades on either side of Shark River Slough are characterized by calcitic marl soils deposited by calcareous algal mats and exposed limerock surfaces with karst features such as solution pits and sinkholes.

South Florida contains three major carbonate aquifer systems. The surficial aquifer system comprises rocks and sediments from the land surface to the top of an intermediate confining unit. The discontinuous and locally productive water bearing units of the surficial aquifer include the Biscayne Aquifer, the undifferentiated surficial aquifer, the coastal aquifer of Palm Beach and Martin Counties, and the shallow aquifer of south Florida. Practically all municipal and irrigation water is obtained from the intermediate aquifer system. The intermediate aquifer system consists of beds of sand, sandy limestone, limestone, and dolostone that dip and thicken to the south and southwest. In much of south Florida, the intermediate aquifer system represents a confining unit that separates the surficial aquifer system from the Floridan aquifer system. The Floridan aquifer system is divided by a middle confining unit into the Upper and Lower Floridan aquifers. In the lower east coast, the Upper Floridan aquifer is being considered for storage of potable water in an aquifer storage and recovery program. In the Lower Floridan aquifer, there are zones of cavernous limestones and dolostones with high transmissivities. However, because these zones contain saline water, they are not used as a drinking water supply and are used primarily for injection of treated effluent wastewater.

3.3 Hydrology

The primary source of water for the ENP comes from direct rainfall and accounts for approximately 70 % of the total influx. The remaining 30% enters the ENP in the form of surface flow. Since 1985, the water delivery management schedule for ENP has followed the Rainfall Plan. The operational target for the managed deliveries under the Rainfall Plan is 45% delivered to Western Shark River Slough (WSRS) (via the S-12 structures) and 55 % delivered to NESRS (via S-333, S-355A, and S-355B). The Rainfall Plan bases the amount and timing of water deliveries to SRS on recent rainfall and evapotranspiration to the north in WCA 3A. Weekly adjustments are made to delivery rates based on the previous week's flow rate and the rainfall and evapotranspiration data from the previous ten weeks. In addition to the Rainfall Plan component, a supplemental stage component is added based on the degree to which average water levels in WCA 3A exceed the regulation schedule. Under normal or dry conditions, this stage component is zero.

To describe the hydrology of the ENP, it is necessary to discuss two of the criteria that are used to evaluate the model runs, hydroperiod distribution and ponding depth. These are outputs from simulation runs for a 31-year period, 1965 to 1995 (Appendix H). The hydroperiod distribution is presented as classes of inundation in days. There are seven classes ranging from 0 to 60 days (dry) to 300 to 365 days (wet). Ponding depths are also used. These are depths above the ground surface and there are six classes ranging from 0.0 to 0.1 feet (dry) to 2.0 to 3.0 feet (wet). The maximum range of inundation in the ENP is aligned along an axis beginning at the northeast corner and extending southwestward through the Park. This axis represents lower ground elevations and, therefore, is the wettest area of the Park. To the northwest of this axis is the western SRS area and to the east and southeast is the L-31N, L-31W, C-111 canals, 8.5 SMA, Rocky Glades, and Taylor Slough. The 8.5 SMA, Rocky Glades and Taylor Slough areas are situated in a relatively drier portion of the Everglades (higher ground. The majority of this higher area is in the 60 to 120 day-inundation range. Adjacent to L31 N, L-31W, and C-111 canals, the inundation is less, and the inundation

increases moving westward from the canals toward the low trough through the center of the Park. The Taylor Slough Area is inundated from 0 to 60 days (generally dry due to higher ground elevations), including parts of the 8.5 SMA and Rocky Glades. To the west near the Big Cypress National Preserve, the inundation class is 60 to 180 days, with inundation for some of the cells increasing to 180 to 240 days along the fringe of the low trough through the center of the Park. Within the 31-year simulation period there are wet and dry years. The year 1995 is presented as a wet year and 1989 is presented as a dry year. For a wet year, the maximum inundation class is 330 to 365 days and covers the entire ENP with the exception of a small area of high ground in the Taylor Slough area adjacent to L-31N and L-31W. For a dry year (1989), the inundation is much less. Along the low trough aligned northeast to southwest the class of inundation decreases to 180 to 300 days. In the eastern area the inundation is 0 to 120 days over the majority of the area. For the high ground, the inundation is in the minimum class (0 to 60 days).

Annual average ponding depth ranges from 0.0 to 0.1 foot in the southeastern portion of the ENP along the L-31N and L-31W canals, and in the Rocky Glades and Taylor Slough areas to depths of 0.5 to 1.0 foot in the center along the northeast to southwest trough and NESRS. The western area is primarily 0.1 to 0.5 foot in ponding depth, with 0.5 to 1.0 foot on the western edge of the low trough and along the west side of L-67 Extension Canal. Simulation runs for an average October, which would represent a wet month, shows deeper depth in all areas, as should be expected. The increment of increase is about 1.0 foot. Simulation runs for an average May, representing a dry month shows a much drier scenario throughout the Park. For the wet trough through the center of the ENP, the ponding depth decreases from 1.0 to 2.0 feet to 0.1 to 0.5 foot for the dry month (May). Although there is a decrease in almost all other areas of the ENP, these decreases are not as dramatic as those in the wet trough.

Specific areas within the project boundaries have distinct hydrologic conditions that could be affected by changes in the water management schedule. These areas are addressed in the ensuing text.

Northeast Shark River Slough (NESRS). NESRS is a complex area located in the northeast corner of the ENP. It is currently the northern terminus of Shark River Slough, which is aligned from the northeast to southwest across the ENP. Tamiami Trail is the northern boundary, the L-31N Canal the eastern boundary, and the L-67 Extension Canal the western boundary of the area. Historically, the area would be characterized as wet the majority of the year, but regional developments have impacted fresh water routes into the area and the dry seasons can significantly reduce surface waters.

Current objectives are to increase the amount of water entering NESRS (being addressed by the MWD project). Water enters NESRS primarily from WCA 3A via S-333 to the L-29 borrow canal and subsequent passage through culverts under Tamiami Trail. In addition, S-355A, S-355B, and G-69 may also be used to deliver water from WCA 3B to the L-29 canal for subsequent passage through the culverts to NESRS. The current operational target for managed deliveries to SRS is 45 % of the regulatory flows delivered to WSRS (via the S-12 structures) and 55 % delivered to NESRS (via S-333, S-355A, and S-355B). Eastern portions of the ENP are also influenced by the system of canals and structures that provide flood control and water supply for the LEC urban and agricultural areas. Efforts to provide flood

control for the Lower East Coast (LEC) have apparently resulted in over-drying and adverse ecological effects in eastern portions of the ENP (USACE 1999a). Over-drainage in the peripheral wetlands along the eastern flank of NESRS has resulted in shifts in community composition, invasion by exotic woody species, and increased susceptibility to fire (USFWS 1999a,b).

The NESRS is an important area with regard to water delivery, but it is a complex area. The average annual number of days of inundation in NESRS ranges from 1 to 60 days, to 240 to 300 days immediately adjacent to L-31N Canal, and to 330 to 365 days toward the west near the L-67 Extension Levee. In a dry year, the range is from 0 to 60 days to 240 to 300 days. In a wet year, such as 1995, the hydroperiod is in the maximum of 300 to 365 days of inundation per year. There is a significant difference between a dry year and a wet year. Average ponding depths generally range from 0.5 to 1.5 feet. For a wet year, depths are about twice the average. For a dry year, depths average from 0.5 to 1.0 foot.

Western Shark River Slough (WSRS). This area, located to the west of L-67 Extension Levee and bounded on the north by the Tamiami Trail, is primarily influenced by operation of the S-12 structures (A, B, C and D). The structures are staggered in operation from west to east in an effort to continue to move some water into SRS but keep it as far east of CSSS subpopulation A as possible. Beginning with structure S-12A it would discharge 10 % of the target flows; S-12B would discharge 20%; S-12C would discharge 30%; and S-12D would discharge 40%. The current overall operational target for managed deliveries to SRS is 45% delivered to WSRS (via the S-12 structures) and 55% delivered to NESRS (via S-333, S-355A, and S-355B). The actual percentage may vary for each regulatory release event.

The average hydroperiod for this area is characterized by days of inundation ranging from 120 to 330 days. The average would be about 240 days. For a wet year such as 1995, the area is inundated 330 to 365 days. A dry year is greatly different. The days of inundation per year range from 60 to as many as 300 but the average would be closer to about 200 days. Average ponding depth ranges from 0.5 to 1.0 feet.

Water Conservation Area 1. (WCA1). WCA1 (Loxahatchee National Wildlife Refuge) is about 21 miles long from north to south and comprises an area of 221 square miles. The West Palm Beach Canal lies at the extreme northern boundary, and on the south, the Hillsborough Canal separates WCA1 from WCA2. Ground elevations slope about five feet in 10 miles, both to the north and to the south from the west center of the area, varying from over 16 feet in the northwest to less than 12 feet NGVD in the south. The area, which is enclosed by about 58 miles of levee (approximately 13 miles of which are common to WCA2), provides storage for excess rainfall, excess runoff from agricultural drainage areas of the West Palm Beach Canal (230 square miles) and the Hillsborough Canal (146 square miles), and excess water from Lake Okeechobee. Inflow comes from rainfall and runoff from the EAA through canals at the northern end. Release of water for dry-season use is controlled by structures in the West Palm Beach Canal, the Hillsborough Canal, and in the north-south levee which forms the eastern boundary of the area. When stages exceed the regulation schedule, excess water in WCA1 is discharged to WCA2.

Water Conservation Areas 2A, 2B (WCA 2A, 2B). WCA 2 is comprised of two areas, 2A and 2B, measures about 25 miles from north to south, and covers an area of 210 square miles. It is separated from the other WCAs by the Hillsborough Canal on the north and the North New River Canal on the south. Ground elevations slope southward about two to three feet in 10 miles, ranging from over 13 feet NGVD in the northwest to less than 7 feet NGVD in the south. The area is enclosed by about 61 miles of levee, of which approximately 13 miles are common to WCA1 and 15 miles to WCA3. An interior levee across the southern portion of the area reduces water losses due to seepage into an extremely pervious aquifer at the southern end of the pool and prevents overtopping of the southern exterior levee by hurricane waves.

Water is passed from this area to WCA 3A via the S-11 structures. In a wet year the entire area is in the 330 to 365 days per year inundation. In a dry year the area is significantly drier with a range of inundation going from 60 to 120 days in the north to 240 to 300 days inundation in the south. The lower end of this area is characterized as wet.

The upper pool, WCA2A, provides a 173 square mile reservoir for storage of excess water from WCA1 and a 125 square mile agricultural drainage area of the North New River Canal. Storage in WCA2A provides water supply to the east coast urban areas of Broward County. Water enters the area from WCA1 and the Hillsborough Canal on the northeast side, and from the North New River Canal on the northwest side. Water in excess of that required for efficient operation of WCA2A is discharged to WCA3 via structures into C-14, the North New River Canal, and WCA2B.

WCA2B has ground elevations ranging from 9.5 feet NGVD in the northern portions down to 7 feet NGVD in the southern portions of the area. The area experiences a high seepage rate, which does not allow for the long-term storage of water, and as a result, water is not normally released from the area.

Water Conservation Areas 3A, 3B (WCA 3A, 3B). WCA3 is divided into two parts, 3A and 3B. It is about 40 miles long from north to south and comprises about 915 square miles, making it the largest of the water conservation areas. Ground elevations, which slope southeasterly one to three feet in 10 miles, range from 13 feet NGVD in the northwest to 6 feet NGVD in the southeast. The Miami Canal traverses the area from northwest to southeast, and the North New River Canal separates it from WCA2. The area is enclosed by about 111 miles of levee, of which 15 miles are common to WCA2. An interior levee system across the southeastern corner of the area reduces seepage into an extremely pervious aquifer.

The upper pool, WCA3A, provides a 752 square mile area for storage of excess water from WCA 2A; rainfall excess from approximately 750 square miles in Collier and Hendry Counties and from 71 square miles of the former Davie agricultural area lying east of Pumping Station S-9 in Broward County; and excess water from a 208 square mile agricultural drainage area of the Miami Canal and other adjacent areas to the north. Water enters WCA3A from various sources on the northern and eastern sides. The storage is used to meet the principal water supply needs of adjacent areas, including urban water supply and salinity control requirements for Dade and Monroe Counties, irrigation requirements, and water supply for ENP.

These areas are located immediately north of the Tamiami Trail and east of the L-30 Canal. The L-67 A and C Canals at Tamiami Trail represents the dividing point between WCA 3A and WCA 3B. WCA 3A is the primary source of water deliveries to the ENP across Tamiami Trail to WSRS through the S-12 Structures and to NESRS via S-333 to the L-29 borrow canal for subsequent passage through culverts under Tamiami Trail and/or discharge to the L-31N Canal via Structure S-334. In addition, S-355A, S-355B, and G-69 may also be used to deliver water from WCA 3B to the L-29 canal for subsequent passage through the culverts to NESRS; however, water cannot be discharged from 355A and 355B when the L-29 stage is above the WCA 3B stage. Simulation runs for existing conditions indicate that WCA 3A is very wet for the majority of the area (±90%). For a wet year, the percentage goes to 100%. For a dry year, there is a wide range of inundation ranging from 60 to 120 days in the north to 330 to 365 days in the southern half and along the eastern border. Conditions in WCA 3B are very similar to conditions just described for WCA 3A. The eastern edge of this conservation area is probably a little drier on average than conditions in the southeastern part of 3A.

Taylor Slough. Taylor Slough is in the southeast quadrant of the ENP. The area through the Rocky Glades and Taylor Slough is a foot or more higher in elevation compared to ground levels north and south or west toward the low trough. Because of this characteristic, the area is normally drier than other areas in the ENP. In a dry year, the hydroperiod is in the lowest class of inundation (0 to 60 days) and ponding depths are 0.0 to 0.1, which is, for all practical purposes, 0. The area is somewhat like an island or a peninsula extending out from the canals into the ENP. Parts of this area have been affected by over-drainage resulting in woody shrub invasion and frequent fires (USFWS 1999b).

Lower East Coast Area (LEC). This area is located to the east of the L-31N, L-31W, and C-111 canals and the Levee divide. The area can be affected by seepage from the canals if water levels are too high. The target, from an agriculture viewpoint, is a low water table, one that is at least two feet below the ground surface. Nine cells are used to examine water levels. The percent of time above the root zone is zero for two of the cells, less than 13% of the time for four cells, less than 31% of the time for two cells, and less than 48% of the time for two cells. The cells are located from south to north as follows: R10-C25; R13-C25; R15-C26; R17-C27; R19-C28; R20-C28; R16-C29; R22-C29; and R24-C30.

8.5 SMA . This area is adjacent to but located on the western side of the L-31N Canal. The north and west boundary is the ENP Expansion area. The southern boundary of the area is the northern boundary of the Rocky Glades area. The area north and west of the 8.5 SMA experience very wet conditions the majority of the time except in very dry years. Average annual hydroperiod simulations indicate that the area experiences from as little as 0 to 60 days inundation on the eastern side to 240 to 300 days on the western side adjacent to the ENP. For a dry year (e.g. 1989) the simulation period shows more than half (eastern half) of the area experiencing 0 to 60 days inundation while the other half (western half adjacent the ENP) experiences 60 to 180 days. For a wet year such as 1995 a small portion immediately adjacent to the L-31N Canal still experiences 0 to 60 days inundation. The remaining portion of the area experiences 180 to 365 days of inundation. Average annual ponding depths are very minor adjacent to the L-31N Canal but increase to 0.5 to 1.0 feet at the western side. In a dry

month such as May, the eastern half of the area is minor depth (0.0 to 0.1 feet). The other half adjacent to the ENP is in the 0.5 to 1.0 feet class. For a wet month only a small percentage of the area on the eastern side remains in the minor depth class. Most of the area is 0.1 to 0.5 feet and 0.5 to 1.0 feet of ponding. Gage G-596 (R18-C26) is located on the eastern side of 8.5 SMA and the stage duration curve shows only 1 or 2% of the time when water levels are above ground level, which supports the hydroperiod and ponding data.

Biscayne Bay. Biscayne Bay is a shallow, tidal sound located near the extreme southeastern part of Florida. Biscayne Bay, its tributaries and Card Sound are designated by the state of Florida as aquatic preserves, while Card and Barnes Sounds are part of the Florida Keys National Marine Sanctuary. A significant portion of the central and southern portions of Biscayne Bay comprise Biscayne National Park.

Depending upon the flood stages reached, all C&SF Project canals in adjacent Dade County can carry floodwaters to Biscayne Bay. However, much of the time, discharges from project canals represent primarily runoff or seepage from within flood protected areas of the county. These flows originate in the extensive networks of secondary drainage canals and storm sewers that discharge into the project canals. Supplementing the complex system of project canals and secondary drainage systems are many hundreds of other stormwater drainage canals and storm sewer outfalls within Dade County that discharge freshwater directly into Biscayne Bay.

Florida Bay. Florida Bay and the Ten Thousand Islands comprise 1,500 square miles of the ENP. The bay is shallow, with an average depth of less than three feet. To the north is the Florida mainland and to the south lie the Florida Keys. Sheet flow across the marl prairies of the southern Everglades and 20 creek systems fed by Taylor Slough and the C-111 Canal provide direct inflow of freshwater to the bay. Surface water from SRS flows into Whitewater Bay and may also provide essential recharge for central and western Florida Bay. Exchange with Florida Bay occurs as this lower salinity water mass flows around Cape Sable into the western subregion of the bay.

Simulations were run for average annual overland flows toward Florida Bay across Craighead Basin, Taylor Slough, and the Eastern Panhandle (Appendix H). These are overland flows, which would be subject to percolation and evapotranspiration losses. The simulation runs provide average annual ground water flows toward Florida Bay across Craighead Basin, Taylor Slough, and Eastern Panhandle. Simulation runs are also available for average annual and monthly average flows toward Whitewater Bay and Florida Bay.

3.4 Water Quality

Water quality in the study area is significantly influenced by development. The C&SF project had led to significant changes in the landscape by opening large land tracts for urban development and agricultural uses, and by the construction of extensive drainage networks. Natural drainage patterns in the region have been disrupted by the extensive array of levees and canals such that nonpoint source (stormwater) runoff and point sources of pollution (wastewater discharges) are now entering the system in many areas. Several pollutants of

concern have been identified and include metals, pesticides, nutrients, biologicals, physical pollutants, and other various industrial constituents. Specifically, phosphorus and pesticides are considered the most important contributers to water quality degradation in the area.

In the central Everglades, phosphorus concentrations entering the ENP were lower in 1997 than the interim and long term limits established by the 1992 Settlement Agreement in United States v. South Florida Water Management District, Case No. 88-1886-CIV-WMH (S.D.Fla.) (Walker 1998). While no significant trends in annual average mercury concentrations in water, sediment, or fish have been observed for the past five years, mercury concentrations in fish tissue were high enough to warrant a no-consumption advisory for largemouth bass throughout most of the eastern two thirds of the ENP, and a recommendation of limited consumption for the southeast corner of the ENP. The best water quality conditions in the ENP were found in the central Shark River Slough and along regions of the basin.

Some parts of Florida Bay have experienced a massive seagrass and mangrove die-off during the late 1980's and early 1990's that likely stems from a lack of circulation, high water temperatures, and increased levels of salinity. Reduction in flow into ENP has reduced freshwater flows to portions of Florida Bay, and the salinity of some portions of the bay has been recorded as high as 70.0 parts per thousand (ppt). The 1997 Everglades Annual Report states that for 1997, the highest observed salinity levels occurred in Whipray Basin, and ranged from 40.6 ppt to 42.3 ppt (water conditions in the bay are considered hypersaline when salinity exceeds 35.0 ppt). Hypersaline conditions were observed throughout most of the western portion of the bay during the dry season; however, they decreased below hypersaline levels once freshwater inputs increased in June 1997.

Groundwater in south Florida consists of the surficial Biscayne Aquifer and the Floridan Aquifer. Both are critical to the ecology and economy of south Florida. The Biscayne Aquifer has been classified as a Sole Source Aquifer under the Federal Safe Drinking Water Act based on the aquifer's susceptibility to contamination and the fact that it is a principal source of drinking water. The Floridan Aquifer system is one of the most productive aquifers in the world and is a multi-use aquifer system. Where it contains freshwater, it is the principal source of water supply. In several places where the Floridan Aquifer contains saltwater, such as along the southeastern coast of Florida, treated sewage and industrial wastes are injected into it.

Because the Biscayne Aquifer is highly permeable and is at or near the land surface in many locations, it is readily susceptible to groundwater contamination. Major sources of contamination are saltwater intrusion and infiltration of contaminants carried in canal water. Additional sources include direct infiltration of contaminants, such as chemicals or pesticides applied to or spilled on the land, or fertilizer carried in surface runoff; leachate from landfills, septic tanks, sewage-plant treatment ponds; and wells used to dispose of storm water runoff or industrial waste.

Water quality monitoring is currently being done in conjunction with the ISOP to determine phosphorus levels in waters entering the Everglades through a number of the water control structures.

3.5 Flood Control

Water management and flood control is achieved in south Florida through a variety of canals, levees, pumping stations, and control structures within the WCAs and ENP/South Dade Conveyance System (SDCS). The WCAs provide a detention reservoir for excess water from the EAA and parts of the east coast region, and for flood discharge from Lake Okeechobee to the sea. The WCAs provide levees to prevent Everglades floodwaters from inundating the east coast urban areas; provide a water supply for the east coast areas and ENP; improve water supply for east coast communities by recharging underground freshwater reservoirs; reduce seepage; ameliorate salt-water intrusion in coastal wellfields; and provide mixed quality habitat for fish and wildlife in the Everglades.

The regulation schedules contain instructions and guidance on how project spillways are to be operated to maintain water levels in the WCAs. The regulation schedules essentially represent the seasonal and monthly limits of storage which guides project regulation for the authorized purposes. The schedules vary from high stages in the late fall and winter to low stages at the beginning of the wet season. These regulation schedules must take into account various, and often conflicting, purposes.

The East Coast Canals are flood control and outlet works that extend from St. Lucie County southward through Martin, Palm Beach, and Broward Counties to Dade County. The East Coast Canal watersheds encompass the primary canals and water control structures located along the lower east coast of Florida and their hydrologic basins. The main design functions of the project canals and structures in the East Coast Canal area are to protect the adjacent coastal areas against flooding; store water in conservation areas west of the levees; control water elevations in adjacent areas; prevent salt-water intrusion and over drainage; provide freshwater to Biscayne Bay and provide for water conservation and public consumption. There are 40 independently operated canals, one levee, and 50 operating structures, consisting of 35 spillways, 14 culverts, and one pump station. The project works to prevent major flood damage. However, due to urbanization, the existing surface water management system now has to handle greater peak flows than in the past.

The ENP/South Dade Conveyance System provides a way to deliver water to areas of south Dade County. This canal system was overlain on top of the existing flood control system. Many of these canals are used to remove water from interior areas to tidewater in times of excess water.

3.6 Wetlands

Wetlands are defined by the Corps (33 CFR 328.3) as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Activities that involve the discharge of dredged or fill material into jurisdictional wetlands and open waters are regulated under Section 404 of the Clean Water Act of 1977, as amended. The Everglades ecosystem is characterized by the unique mosaic of freshwater wetland communities that dominates the landscape between Lake

Okeechobee and Florida Bay. Everglades' wetlands comprise a highly productive system of open water sloughs and marshes, dense grass- and sedge-dominated marshes, forested islands, and wet marl prairies. The Everglades has experienced dramatic impacts over the last century, with approximately one-half of the original 1.2 million-hectare system of wetlands being lost to urban and agricultural development. The remaining wetlands have largely been negatively affected by water management practices that have altered the natural Everglades hydrological regime. A more thorough discussion of wetland types, trends, and impacts are included with the vegetative community descriptions in the following section.

3.7 Vegetation

The Everglades landscape is dominated by a complex of freshwater wetland communities that includes open water sloughs and marshes, dense grass- and sedge-dominated marshes, forested islands, and wet marl prairies. The primary factors influencing the distribution of dominant freshwater wetland plant species of the Everglades are soil type, soil depth, and hydrological regime (USFWS 1999b). These communities generally occur along a hydrological gradient with the slough/open water marsh communities occupying the wettest areas (flooded more than nine months per year), followed by sawgrass marshes (flooded six to nine months per year), and wet marl prairie communities (flooded less than six months per year) (USFWS 1999b). The freshwater wetlands of the Everglades eventually grade into intertidal mangrove wetlands and subtidal seagrass beds in the estuarine waters of Florida Bay.

Development and drainage over the last century have dramatically reduced the overall spatial extent of freshwater wetlands within the Everglades, with approximately half of the predrainage 1.2 million hectares of wetlands being converted for development and agriculture (Davis et al. 1997). Alteration of the normal flow of freshwater through the Everglades has also contributed to conversions between community types, invasion by exotic species, and a general loss of community diversity and heterogeneity. Recent vegetative trends in the ENP have included a substantial shift from the longer hydroperiod slough/open water marsh communities to shorter hydroperiod sawgrass marshes (Davis et al. 1997). In addition, invasion of sawgrass marshes and wet prairies by exotic woody species has led to the conversion of some marsh communities to forested wetlands (Gunderson 1997).

Vegetative communities of the WCAs have suffered from both over drainage and prolonged periods of inundation associated with the stabilization of water levels (USACE 1999a). Increased flooding and water depths in WCA 2A have resulted in the loss of wet prairie communities, drowning of tree islands, and loss of sawgrass marshes along slough edges. Major plant communities of WCA 2A now consist of remnant (drowned) tree islands, open water sloughs, and large expanses of sawgrass and sawgrass-cattail marshes. The increase in cattails in WCA 2A is attributed to increased nutrient loading associated with agricultural runoff. WCA 2B has suffered from lowered water levels resulting in heavy melaleuca infestations throughout the area. Increased deliveries of water to WCA 2B associated with drawdowns of WCA 2A in the 1980's has helped somewhat to slow the advance of melaleuca. Many areas of WCA 3A still contain relatively good wetland habitat consisting of a complex of tree islands, sawgrass marshes, wet prairies, and aquatic sloughs. However, the northern

portion of WCA 3A has been over drained, resulting in increased fire frequency and the associated loss of tree islands; wet prairie; and aquatic slough habitat. Northern WCA 3A is currently dominated largely by monospecific sawgrass stands and lacks the diversity of communities that exists in southern WCA 3A. WCA 3B contains typical Everglades vegetation including tree islands, wet prairies, sawgrass marshes, and aquatic sloughs.

The estuarine communities of Florida Bay have also been affected by upstream changes in freshwater flows through the Everglades. A reduction in freshwater inflows into Florida Bay and alterations of the normal salinity balance have affected mangrove community composition and may have contributed to a large-scale die-off of seagrass beds (USFWS 1999b).

In contrast to the vast extent of wetland communities, upland communities comprise a relatively small component of the Everglades landscape and are largely restricted to Long Pine Key, the northern shores of Florida Bay, the many tree islands scattered throughout the region. Vegetative communities of Long Pine Key include rockland pine forest and tropical hardwood forest. In addition, substantial areas of tropical hardwood hammock occur along the northern shores of Florida Bay and on elevated portions of some forested islands.

Slough/Open Water Marsh

The slough/open water marsh community occurs in the lowest, wettest areas of the Everglades. This community is a complex of open water marshes containing emergent, floating aquatic, and submerged aquatic vegetation components. The emergent marsh vegetation is typically dominated by spikerushes (*Eleocharis cellulosa* and *E. elongata*), beakrushes (*Rhynchospora tracyi* and *R. inundata*), and maidencane (*Panicum hemitomon*). Common floating aquatic dominants include fragrant water lily (*Nymphaea odorata*), floating hearts (*Nymphoides aquatica*), and spatterdock (*Nuphar lutea*); and the submerged aquatic community is typically dominated by bladderwort (*Utricularia foliosa*) and periphyton. Recent vegetative trends in the ENP have included the conversion of slough/open water marsh communities to shorter hydroperiod sawgrass marshes (Davis et al. 1997).

Sawgrass Marsh

Sawgrass marshes are dominated by dense to sparse stands of *Cladium jamaicense*. Sawgrass marshes occurring on deep organic soils (>1 meter) form tall, dense, nearly monospecific stands. Sawgrass marshes occurring on shallow organic soils (<1 meter) form sparse, short stands that contain additional herbaceous species such as spikerush (*Eleocharis cellulosa*), water hyssop (*Bacopa caroliniana*), and marsh mermaid weed (*Proserpinaca palustris*) (Gunderson 1997). The adaptations of sawgrass to flooding, burning, and oligotrophic conditions contribute to its dominance of the Everglades vegetation. Sawgrass-dominated marshes once covered an estimated 300,000 acres of the Everglades. Approximately 70,000 acres of tall, monospecific sawgrass marshes have been converted to agriculture in the EAA. Urban encroachment from the east and development within other portions of the Everglades has consumed an additional 125,000 hectares of sawgrass-dominated communities (Davis et al. 1997).

Wet Marl Prairies

Wet marl prairies occur on marl soils and exposed limestone and experience the shortest hydroperiods of the slough/marsh/prairie wetland complex. Marl prairie is a sparsely vegetated community that is typically dominated by muhly grass (*Muhlenbergia capillaris*) and short-stature sawgrass. Additional important constituents include blackrush (*Schoenus nigricans*), arrowfeather (*Aristida purpurascens*), Florida bluestem (*Schizachyrium rhizomatum*), and Elliot's lovegrass (*Eragrostis elliottii*). Periphyton mats that grow loosely attached to the vegetation and exposed limestone also form an important component of this community. Marl prairies occur in the southern Everglades along the eastern and western periphery of Shark River Slough. Approximately 59,000 hectares of the eastern marl prairie has been lost to urban and agricultural encroachment (Davis et al. 1997).

Tree Islands

Tree islands occur within the freshwater marshes on areas of slightly higher elevation relative to the surrounding marsh. The lower portions of tree islands are dominated by hydrophytic, evergreen, broad-leaved hardwoods such as red bay (*Persea palustris*), sweetbay (*Magnolia virginiana*), dahoon holly (*Ilex cassine*), and pond apple (*Annona glabra*). Tree islands typically have a dense shrub layer that is dominated by cocoplum (*Chrysobalanus icaco*). Additional constituents of the shrub layer commonly include buttonbush (*Cephalanthus occidentalis*) and large leather fern (*Acrostichum danaeifolium*). Elevated areas on the upstream side of some tree islands may contain an upland, tropical hardwood hammock community dominated by species of West Indian origin (Gunderson 1997). Extended periods of flooding may result in tree mortality and conversion to a non-forested community. Portions of the WCAs have been flooded to the extent that many forested islands have lost all tropical hardwood hammock trees. Tree islands are considered an extremely important contributor to habitat heterogeneity and overall species diversity within the Everglades ecosystem (USFWS 1999b).

Mangroves

Mangrove communities are forested wetlands occurring in intertidal, low-wave-energy, estuarine and marine environments. Within the project area, extensive mangrove communities occur in the intertidal zone of Florida Bay. Mangrove forests have a dense canopy dominated by four species: red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), white mangrove (*Laguncularia racemosa*), and buttonwood (*Conocarpus erectus*). Mangrove communities occur within a range of salinities from 0 to 40 ppt. Florida Bay experiences salinities in excess of 40 ppt on a seasonal basis. Declines in freshwater flow through the Everglades have altered the salinity balance and species composition of mangrove communities within Florida Bay. Changes in freshwater flow can lead to an invasion by exotic species such as Australian pine (*Casuarina equisetifolia*) and Brazilian pepper (*Schinus terebinthifolius*).

Seagrass Beds

Seagrasses are submerged vascular plants that form dense rooted beds in shallow estuarine and marine environments. This community occurs in subtidal areas that experience moderate wave energy. Within the project area, extensive seagrass beds occur in Florida Bay. The most abundant seagrasses in south Florida are turtle grass (*Thalassia testudinum*), manatee grass (*Syringodium filiforme*), and shoal grass (*Halodule wrightii*). Additional species include star grass (*Halophila engelmannii*), paddle grass (*Halophila decipiens*), and Johnson's seagrass (*Halophila johnsonii*). Widgeon grass may also occur in seagrass beds in areas of low salinity. Seagrasses have an optimum salinity range of 24 to 35 ppt, but can tolerate considerable short term salinity fluctuations. Large-scale seagrass die-off has occurred in Florida Bay since 1987, with over 18% of the total bay area affected. Suspected causes of seagrass mortality include high salinities and temperatures during the 1980s and long-term reductions of freshwater inflow to Florida Bay.

Rockland Pine Forest

Pine rocklands within the project area occur on the Miami Rock Ridge and extend into the Everglades as Long Pine Key. Pine rocklands occur on relatively flat terrain with moderately to well-drained soils. Most sites are wet for only short periods following heavy rains (FNAI 1990). Limestone bedrock is close to the surface and the soils are typically shallow accumulations of sand, marl, and organic material. Pine rockland is an open, savanna-like community with a canopy of scattered south Florida slash pine (*Pinus elliottii* var.*densa*) and an open, low-stature understory. This is a fire-maintained community that requires regular burns to maintain the open shrub/herbaceous stratum and to control hardwood encroachment (Gunderson 1997). The overstory is comprised of scattered south Florida slash pines. The shrub layer is comprised of a diverse assemblage of tropical and temperate species. Common shrubs include cabbage palm (*Sabal palmetto*), coco-plum (*Chrysobalanus icaco*), myrsine (*Rapanea punctata*), saw palmetto (*Serenoa repens*), southern sumac (*Rhus copallinum*), strangler fig (*Ficus aurea*), swamp bay (*Persea palustris*), wax myrtle (*Myrica cerifera*), white indigo berry (*Randia aculeata*), and willow-bustic (*Sideroxylon salicifolium*). The herbaceous stratum is comprised of a very diverse assemblage of grasses, sedges, and forbs. Common herbaceous species include *Schizachyrium sanguineum*, *S. gracile*, *Andropogon longiberbis*, *A. glomeratus* var. *pumilis*, candyweed (*Polygala grandiflora*), creeping morning-glory (*Evolvulus sericeus*), pineland heliotrope (*Heliotropium polyphyllum*), rabbit bells (*Crotolaria rotundifolia*), and thistle (*Cirsium horridulum*) (USFWS 1999b). This community occurs on areas of relatively high elevation and consequently, has been subject to intense development pressure. In addition, fragmentation, fire suppression, invasion by exotic species, and a lowered water table have negatively affected the remaining tracts of pine rockland (USFWS 1999a).

Tropical Hardwood Hammock

Tropical hardwood hammocks occur on upland sites where limestone is near the surface. Tropical hardwood hammocks within the project area occur on the Miami Rock Ridge, along the northern shores of Florida Bay, and on elevated outcrops on the upstream side of tree islands. This community consists of a closed canopy forest dominated by a diverse

assemblage of hardwood tree species, a relatively open shrub layer, and a sparse herbaceous stratum. This community is dominated by West Indian species and contains numerous species whose entire United States distribution is limited to tropical hammocks of south Florida. Common canopy species include gumbo-limbo (*Bursera simaruba*), paradise tree (*Simarouba glauca*), pigeon-plum (*Coccoloba diversifolia*), strangler fig (*Ficus aurea*), wild mastic (*Sideroxylon foetidissimum*), willow-bustic, live oak (*Quercus virginiana*), short-leaf fig (*Ficus citrifolia*), and wild tamarind (*Lysiloma bahamense*). Common understory species include black ironwood (*Krugiodendron ferreum*), inkwood (*Exothea paniculata*), lancewood (*Ocotea coriacea*), marlberry (*Ardisia escallonoides*), poisonwood (*Metopium toxiferum*), satinleaf (*Chrysophyllum oliviforme*), and white stopper (*Eugenia axillaris*). Common species of the sparse shrub/herbaceous layer include shiny-leaf wild-coffee (*Psychotria nervosa*), rouge plant (*Rivinal humilis*), false mint (*Dicliptera sexangularis*), bamboo grass (*Lasciacis divaricata*), and woods grass (*Oplismenus hirtellus*). This community occurs on areas of relatively high elevation and consequently, has been subject to intense development pressure. Fragmentation of remaining tracts, invasion by exotic species, and alterations of water table elevations have also had negative impacts on this community. Tropical hardwood hammocks on the Miami Rock Ridge have been affected by a lowered water table associated with the reduction of freshwater flow through the Everglades. In contrast, tree islands in the water conservation areas have been flooded to the extent that many have lost all tropical hardwood hammock trees.

3.8 Fish and Wildlife

Aquatic macroinvertebrates form a vital link between the algal and detrital food web base of freshwater wetlands and the fishes, amphibians, reptiles, and wading birds that feed upon them. Important macroinvertebrates of the freshwater aquatic community include crayfish (*Procambarus alleni*), riverine grass shrimp (*Palaemonetes paludosus*), amphipods (*Hyallela aztecus*), Florida apple snail (*Pomacea paludosa*), Seminole ramshorn (*Planorbella duryi*), and numerous species of aquatic insects (USACE 1999a).

Small freshwater marsh fishes are also important processors of algae, plankton, macrophytes, and macroinvertebrates. Marsh fishes provide an important food source for wading birds, amphibians, and reptiles. Common small freshwater marsh species include the golden topminnow (*Fundulus chrysotus*), least killifish (*Heterandria formosa*), Florida flagfish (*Jordenella floridae*), golden shiner (*Notemigonus crysoleucas*), sailfin molly (*Poecilia latipinna*), bluefin killifish (*Lucania goodei*), oscar (*Astronotus ocellatus*), eastern mosquitofish (*Gambusia holbrookii*), and small sunfishes (*Lepomis* spp.) (USACE 1999a). The density and distribution of marsh fish populations fluctuates with seasonal changes in water levels. Populations of marsh fishes increase during extended periods of continuous flooding during the wet season. As marsh surface waters recede during the dry season, marsh fishes become concentrated in areas that hold water through the dry season such as alligator holes, limestone solution holes, and longer-hydroperiod marshes and sloughs. Concentrated dry season assemblages of marsh fishes are more susceptible to predation and provide an important food source for wading birds (USACE 1999a).

Numerous sport and larger predatory fishes occur in deeper canals and sloughs. Common species include largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), black crappie (*Pomoxis nigromaculatus*), Florida gar (*Lepisosteus platyrhincus*), threadfin shad (*Dorosoma petenense*), gizzard shad (*Dorosoma cepedianum*), yellow bullhead (*Ameiurus natilis*), white catfish (*Ameiurus catus*), bowfin (*Amia calva*), and tilapia (*Tilapia* spp.) (USACE 1999a). Larger fishes are an important food source for wading birds, alligators, otters, raccoons, and mink.

The freshwater wetland complex supports a diverse assemblage of reptiles and amphibians. Common amphibians include the greater siren (*Siren lacertina*), Everglades dwarf siren (*Pseudobranchus striatus*), two-toed amphiuma (*Amphiuma means*), pig frog (*Rana grylio*), southern leopard frog (*Rana sphenocephala*), Florida cricket frog (*Acris gryllus*), southern chorus frog (*Pseudacris nigrita*), squirrel tree frog (*Hyla squirela*), and green tree frog (*Hyla cinerea*) (USACE 1999). Amphibians represent an important forage base for wading birds, alligators, and larger predatory fishes (USACE 1999a).

Common reptiles of freshwater wetlands include the American alligator (*Alligator mississippiensis*), snapping turtle (*Chelydra serpentina*), striped mud turtle (*Kinosternon bauri*), mud turtle (*Kinosternon subrubrum*), cooter (*Chrysemys floridana*), Florida chicken turtle (*Deirochelys reticularia*), Florida softshell turtle (*Trionys ferox*), water snake (*Natrix sipidon*), green water snake (*Natrix cyclopion*), mud snake (*Francia abacura*), and Florida cottonmouth (*Agkistrodon piscivorus*) (USACE 1999a).

The alligator was historically most abundant in peripheral Everglades marshes and freshwater mangrove habitats but is now most abundant in canals and the deeper slough habitats of the central Everglades. Drainage of peripheral wetlands and increasing salinity in mangrove wetlands as a result of decreased freshwater flows has limited the occurrence of alligators in these habitats (Mazzotti and Brandt 1997).

The freshwater wetlands of the Everglades are noted for their abundance and diversity of colonial wading birds. Common wading birds include the white ibis (*Eudocimus albus*), glossy ibis (*Plegadus falcenellus*), great egret (*Casmerodius albus*), great blue heron (*Ardea herodius*), little blue heron (*Egretta caerulea*), tricolored heron (*Egretta tricolor*), snowy egret (*Egretta thula*), green-backed heron (*Butorides striatus*), cattle egret (*Bubulcus ibis*), black-crowned night heron (*Nycticorax nycticorax*), yellow-crowned night heron (*Nycticorax violacea*), roseate spoonbill (*Ajaia ajaja*), and wood stork (*Mycteria americana*) (USACE 1999a).

Populations of breeding wading birds in the Everglades have decreased by approximately 90%, and the distribution of breeding birds has shifted away from the ENP into the WCAs (Bancroft et al. 1997). The WCAs support fewer numbers of breeding pairs with relatively lower reproductive success (USACE 1999a). Water management practices and wetland losses are believed to be the primary cause of the declines (Bancroft et al. 1997). Seasonal drydown and the associated concentration of prey in isolated pools is a critical component of wading bird ecology in the Everglades. Historically, wading birds bred primarily during the winter-spring dry season when prey became concentrated in these drying pools (Bancroft et al. 1997). Successful breeding requires a continuous source of prey within the foraging range

of the nesting site (Hoffman et al. 1997). Changes in the availability of prey resulting from wetland losses and water management practices are believed to have contributed to the declines in breeding wading bird populations (Bancroft et al. 1997). Many foraging wading birds avoid dense, high sawgrass marshes and show a preference for slough/sawgrass marsh/ tree island mosaics that provide foraging habitat over a wider range of water stages (Hoffman et al. 1997). Recent vegetative trends have included substantial conversions of the wetter slough-open water marsh communities to dense sawgrass marshes and an apparent reduction in aquatic productivity (Davis et al. 1999). In addition, the important low salinity mangrove fish assemblage has been depleted as a result of changes in the salinity regime. Abandonment of the traditional breeding colony locations of the southern Everglades is largely attributed to declines in the freshwater marsh and mangrove food bases (USACE 1999a).

Mammals that are well-adapted to the aquatic and wetland conditions of the freshwater marsh complex include the rice rat (*Oryzomys palustris natator*), round-tailed muskrat, and river otter (*Lutra canadensis*). Additional mammals that may utilize freshwater wetlands on a temporary basis include the white-tailed deer (*Odocoileus virginianus*), Florida panther (*Puma concolor coryi*), bobcat (*Lynx rufus*), and racoon (*Procyon lotor*).

3.9 Protected Species

The USFWS (1999b) has determined that ten federally-listed species may occur within the area affected by the proposed action. The effects of the Experimental Program, Modified Water Deliveries Project, and C-111 Project on listed species and their critical habitat were summarized by the USFWS in a 1999 Biological Opinion (Appendix D). The Biological Opinion included a jeopardy opinion for the CSSS. The jeopardy opinion for the CSSS led to implementation of the current ISOP and the development of the proposed IOP. Detailed accounts of these species, including descriptions of their distribution; habitat; critical habitat; reproduction; foraging; movements, status and trends; and respective recovery plan objectives, are contained in Appendix D. Additional information regarding these species can be found in the *South Florida Multi-Species Recovery Plan* (USFWS 1999b). Table 3.1 provides a list of federally protected species addressed in the BO.

Table 3.1 Federally Listed Species That May Occur Within the Project Area

Common Name	Scientific Name	Federal Status
CSSS*	*Ammodramus maritimus mirabilis*	Endangered
Snail Kite*	*Rostrahamus sociabilis plumbeus*	Endangered
Wood Stork	*Mycteria americana*	Endangered
American Crocodile*	*Crocodylus acutus*	Endangered
West Indian Manatee*	*Trichechus manatus*	Endangered
Florida Panther	*Felis concolor coryi*	Endangered
Red-cockaded Woodpecker	*Picoides borealis*	Endangered
Bald Eagle	*Haliaeetus leucocephalus*	Threatened
Eastern Indigo Snake	*Drymarchon corais couperi*	Threatened
Garber's Spurge	*Euphorbia garberi*	Threatened

*Designated critical habitat

3.10 Air Quality

The existing air quality within south Florida is considered good, and the region is in attainment for all National Ambient Air Quality Standards. Primary sources of air pollution in south Florida, including Dade County and the ENP, are related to transportation, stationary fuel combustion sources, and solid waste disposal.

3.11 Noise

Within the major natural areas of south Florida, external sources of noise are limited and of low occurrence. Rural areas typically have noise levels in the range of 34 to 70 decibels, and urban areas may attain noise levels of 90 decibels or greater. Noise levels within the ENP are associated predominately with the natural undeveloped landscape, with recreational traffic and occasional air traffic contributing intermittent higher levels.

3.12 Aesthetics

The visual characteristics of south Florida can be described according to the three dominant land use categories (natural areas, agricultural lands, and urban areas). The natural areas consist of a variety of upland and wetland ecosystems, including lakes, ponds, vast expanses of marsh and wet prairie, with varying vegetative components. Uplands are often dominated by pine, although other sub-tropical and tropical hardwoods such as fig, gumbo limbo, and cypress occur within their ecotone. Overall, the land is extremely flat, with few natural topographic features. Much of the visible topographic features are man-made, including canals and levees. Additional man-made features include pump stations, navigation locks, secondary and primary roads, highways, electrical wires, communication towers, occasional buildings, and borrow pits.

3.13 Recreation

Recreational opportunities are abundant in south Florida. In addition to the marine based recreation activities of the urbanized east coast, the ENP and WCAs provide high quality boating, fishing, hiking, and nature interpretation activities which annually attract many recreational visitors.

The ENP has been designated a World Heritage Site, an International Biosphere Reserve, and a Wetland of National Significance. In addition, 86% of the ENP is designated Wilderness under the Wilderness Act of 1964. The State of Florida has designated ENP an Outstanding Florida Water.

3.14 Land Use

The existing land use within the project boundaries varies widely from agricultural to high-density multi-family and industrial urban uses. A large portion of south Florida remains natural, although much of it is disturbed land. The dominant natural features are the federally protected ENP, Biscayne National Park, Big Cypress National Preserve, and the state-protected WCAs. Generally, urban development is concentrated along the lower east coast from Palm Beach County to Dade County.

The lower east coast extends approximately 100 miles through the coastal portions of Palm Beach, Broward, and Dade Counties. As the most densely populated subregion in the state, the lower east coast is home to one third of the state's population, more than 4.5 million people. The subregion is primarily an urban megalopolis, but it also contains substantial agricultural acreage, particularly in southwestern Dade County (90,000 acres). Rapid population growth and land development practices have resulted in notable western urban sprawl; the predominant land use is single-family residential. The once significant rural population in the western areas of Broward County has practically disappeared, resulting in an urbanized makeup in population.

Much of land within the area potentially impacted by the proposed project is within the ENP and is publicly owned. However, a number of privately owned parcels still exist within this region, and purchase of these parcels is currently underway. .It is anticipated that most of these properties will be in public ownership prior to project implementation. .In addition, the 8.5 SMA, also known as the East Everglades Agricultural and Residential Area, is located between the ENP on the west and the L-31N flood protection levee on the east. Over 50 percent of this land is in private ownership and is a combination of residential, vacant lands, row crops, tree farms, specialty farms, and mixed agricultural land use.

3.15 Socioeconomics

Florida's economy is characterized by strong wholesale and retail trade, government, and service sectors. The economy of south Florida is based on services, agriculture, and tourism. Florida's warm weather and extensive coastline attract vacationers and other visitors and help make the state a significant retirement destination. The three counties that comprise the lower east coast (Palm Beach, Broward, and Dade) are heavily populated, and it is estimated that over 6.9 million people will reside in this region by the year 2050.

A complete socioeconomic description of the C&SF area was completed in the Comprehensive Review Study (USACE 1999a).

3.16 Agriculture

The Miami-Dade County agricultural industry is unique in both the types of commodities produced and the method of cultivation. The majority of agricultural activities in the county are located south of Tamiami Trail and east of the ENP. A variety of vegetables, fruits, and

ornamentals are grown within this region and include many tropical and subtropical crops which are grown year-round. The most active growing season is between September and May. Because of the wet and dry rainy seasons in the area, planting times are controlled by the elevation of ground water.

Soils in these agricultural areas are rocky soils and marl soils. The finer texture of the marl soils make them more suitable for tuber crops such as potatoes and ornamentals requiring root balls when harvested. The rocky soils, including rockdale and rockland, require a preparation process which gives this type of farming a unique character. It is necessary to break the hard limestone outcroppings into smaller particles by scarifying or rock plowing before cultivation can take place. When the material is sufficiently pulverized, the fields are prepared in row mounds to gain added protection from the high water tables. Extensive fertilizer is used in both marls and rockland soil farming.

3.17 Hazardous, Toxic, and Radioactive Materials

A preliminary Phase I Hazardous, Toxic, and Radioactive Waste (HTRW) assessment was conducted in August 1998 to address the potential for occurrence of HTRW on lands within the full scope of the C&SF project in the study area (USACE 1999a). The assessment included a project review, review of site literature and aerial photography, database search, review of available records, and assessment of specific indicators such as landfills, dumps, disposal areas, aboveground and underground storage tanks, vats, containers of unidentified substances, spills, seepage, slicks, odors, dead or stressed vegetation, treatment plants, wells, ditches, abandoned buildings, and transportation-related areas. No specific sites were identified within the "footprint" of the proposed structures. Lands related to the C-111 Project were also surveyed for HTRW by the SFWMD prior to that agency's transfer and certification of lands to the Federal Government.

3.18 Cultural Resources

Florida was inhabited by humans as early as 12,000 years ago during the Paleo-Indian stage, which lasted until 7,500 B.C. By the time the Spanish and French explorers arrived during the 16th century, approximately 10,000 Calusas inhabited southern Florida. The Calusas were hunters and gatherers primarily concentrated along the coastal areas, subsisting on fish, shellfish, and wild vegetation. Disease and invasion drastically reduced the Calusa population over the course of the following decades.

The Miccosukees, who still inhabit the region, are descendents of the Hitchiti-speaking Lower Creeks, and the Seminoles, who are also prominent in the region, are descendents of the Muskogee-speaking Upper Creeks. These groups migrated to Florida in the 18th and 19th centuries from Georgia and Alabama.

By the early 1800's, the migrant Native American population of Florida had grown to about 5,000. The Miccosukees and Seminoles migrated to south Florida and established themselves in the Everglades, the Big Cypress Swamp, and the Ten Thousand Islands. Most of the people lived on upland tree islands (hammocks), and used dugout canoes for transportation,

hunting, and trading. Dwellings, called chickees, were constructed of cypress logs and palm fronds. The traditional lifestyle endured for the remainder of the century and still endures to some extent today.

While documented prehistoric or historic sites within the project area are few, the numerous tree islands located throughout the ENP have potential for future historic discovery. Archeological deposits may be buried as much as 2 meters below the surface. Human burials are occasionally found in the area within shell middens or within isolated solution holes.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 Climate

None of the project alternatives would have any effect on climate.

4.2 Geology and Soils

There would be no significant impacts to geology or soils with any of the project alternatives. No earth moving or construction activities are associated with Alternatives 1 through 5, and surface water patterns would not change to the degree that would cause any alterations in soils or groundwater recharge. Alternatives 6 and 7 would require some excavation with construction of a 240 acre seepage reservoir. However, exposure of the soils would be short-term, and impacts would be minor and temporary. Appropriate erosion and sedimentation control measures would be incorporated and applied to construction efforts. Additional construction would occur concurrently with Alternative 7R, but impacts associated with construction of those components were previously addressed under the C-111 and MWD NEPA documents.

4.3 Hydrology

To help visualize the changes to hydrology and performance measures, a large number of color figures were provided in Appendix H of the DEIS and Appendix A of the SDEIS. However, there are many more figures that would be of interest on the website: www.saj.usace.army.mil on the Sparrow Issues page.

One of the performance measures of interest in the WCA is the number of weeks the water depth would be above 2.5 feet (relative to the average ground elevation). When reviewing this performance measure, it is important to remember that there are 1612 weeks in the modeling period of record (from 1965 through 1995). Under RPA02, for example, there were 566 weeks with depths greater than 2.5 feet as compared to 519 for the 95BaseMod2 condition and 475 weeks for the No Action Alternative (Alternative 1 or ISOP2001) condition in southern WCA 3A.

Reasonable and Prudent Alternative (RPA)

The RPA, as given, could not be directly implemented, because releases from S-333 are currently limited by high stage criteria at G-3273. Furthermore, higher canal stages in L-31N, as envisioned in Test 7 Phase II, depended upon the full use of the S-332D pump station. Under the FWS B.O., pumping volume at S-332D pump station was limited during the nesting season (165cfs instead of 500cfs). For example, the maximum stage reached in cell R17C27 would have been about 0.48 feet higher under RPA02 (7.16 feet) than in the 1995BaseMod2 condition (6.65 feet). It should also be noted that increasing the flows southward down L-31N, in addition to raising canal pump criteria, results in higher stages

than simply raising the canal pump criteria alone. Under ISOP, additional water is moved down L-31N to help meet the S-333 release requirements. Under the RPA02, slightly more water would enter L-31N due to increased seepage from the higher stages in NESRS. The target flows for RPA02 were 60% of the regulatory release through S-333, when not limited by structural capacity, into NESRS. Although the RPAs could not be directly implemented, several RPAs were modeled to determine the desired hydrologic characteristics in the sparrow regions. RPA02 best represents the sparrow requirements for all the CSSS subpopulations. Detailed descriptions of the RPA model runs can be found on the Corps web site.

Comparisons of 1995BaseMod2, ISOP 2000 (ISOP9d) and ISOP 2001 (ISOP9dR)

The following discussions covers modeled consequences of implementing the various alternatives based on actual rainfall during the 31-year period of record. Evaluations for ISOP 2000 and ISOP 2001 were based on model results for the same 31-year period of record and not what actually occurred during those years to provide an accurate comparison to the other alternatives. It should be noted that 2000 was an unusually wet year, while 2001 was extremely dry. Therefore, neither year would be considered "average".

NESRS. The stages in NESRS from both ISOP 2000 and ISOP 2001 are similar to the stages from 1995BaseMod2. While the stages from ISOP 2000 and 1995BaseMod2 are virtually identical, the stages of ISOP 2001 are about 0.1 foot lower than 1995BaseMod2 for about 20 percent of the time (SDEIS A-18 and A-19). ISOP 2001 supplies about 9,000 acre-feet/year less into NESRS than does ISOP 2000 (SDEIS A-42) because more flow is passed through S-12D (which can be used throughout the year). The hydroperiods for all three of the operational scenarios are the same.

The hydrologic conditions under ISOP 2001 are similar to ISOP 2000 at subpopulations B, C, D, and E (SDEIS A-27 to A-38). At subpopulation F, there is a significant improvement in the stages and consecutive number of nesting days under ISOP 2001 (SDEIS A-39 to A-41). There is also a reduction in the discontinuous hydroperiod (SDEIS A-40); however, ISOP 2001 still exceeds the requirement of RPA02.

WSRS. ISOP 2001 conditions are similar to the ISOP 2000, with regard to impacts to WSRS, except that the higher stages are slightly reduced (SDEIS A-20 and A-21) which is a benefit. With the changed closing schedule for the S-12 structures, about 28,000 acre-feet more water (SDEIS A-42) is passed through the region from WCA3A during ISOP 2001 operations as compared to ISOP 2001. The increase in flow is primarily directed southward from S-12D, which is the most eastward S-12 structure and does not impact the western CSSS subpopulation.

As intended, the stages and hydroperiods in WSRS are lower than 1995BaseMod2 due to the reduction of flows through the S-12s. The reduction benefits the western subpopulation by reducing the number of nesting failures. The stages and consecutive number of nesting days are slightly improved for subpopulation A under ISOP 2001. The number of predicted failures (over the 31-year period of record) at NP205 for ISOP 2001 is the same (five) as under ISOP 2000, RPA00, RPA01, and RPA02. The number of nesting failures for 1995BaseMod2 was 8.

WCA 1. The stages in WCA 1 from both ISOP 2000 and ISOP 2001 are the same as the stages from 1995BaseMod2 (SDEIS A-4). The wet and dry season hydrologic pattern of ISOP2001 did not change from ISOP 2000; however, there were slightly fewer weeks of high water events (SDEIS A-5).

WCA 2A and WCA 2B. The stages of ISOP 2000 were dramatically higher in WCA 2A (SDEIS A-6) and WCA 2B (SDEIS A-8) due to the raising of the regulatory curve in WCA 2A. However, ISOP 2001 did not include the elevated regulatory curve in WCA 2A and the stages matched the 1995BaseMod2 conditions. The number of weeks of high water in WCA 2A was reduced from 65 weeks in ISOP2000 to 2 weeks in ISOP2001 (SDEIS A-7). Similarly, the number of weeks of high water in WCA 2B was reduced from 729 to 260 weeks (SDEIS A-9).

WCA 3A and WCA 3B. While the stages produced in South WCA 3A by ISOP 2000 and ISOP 2001 are similar to the 1995BaseMod2 stages, there are some slightly lower stages (0 to 0.2 feet) in the stages from 1 to 2.5 feet for ISOP2000 and ISOP2001 (SDEIS A-10). Similarly, the weeks of damaging high water stages were reduced from 519 weeks in 1995BaseMod2 to 487 weeks for ISOP 2000 and 475 weeks for ISOP 2001 (SDEIS A-11). The same pattern is seen in South Central WCA 3A (SDEIS A-12 and A-13). In WCA 3B, both ISOPs produced slightly higher (>0.2 feet) stages (SDEIS A-14) but did not increase the number of damaging high stages (SDEIS A-15).

Taylor Slough. The stages in Taylor Slough were essentially unchanged between 1995BaseMod2, ISOP 2000, and ISOP 2001 (SDEIS A-16 and A-17).

East Coast Agricultural Area. The stages in the agricultural areas east of L-31N show little difference between the 1995BaseMod2 conditions and either ISOP 2000 or ISOP 2001, and there is no pattern of improvement or detriment (SDEIS A-47). Although both ISOP 2000 and ISOP 2001 move more water through the L-31N canal, the increased pumping capacity of both S-332D and S-332B moves more water into the ENP. To aid in the moving of the water from the north to the south reaches of L-31N, the lower reach pumping triggers were lowered to increase the ability to move water through the canal and into the ENP.

8.5 SMA. The 1995BaseMod2 stage values remain essentially unchanged for either ISOP 2000 or ISOP 2001 (SDEIS A-46).

Biscayne Bay. Only the South Bay region of the greater Biscayne Bay showed a significant difference in flows to the bay (SDEIS A-43). During the wet season, ISOP 2000 showed a 21,000 acre-feet increase and ISOP 2001 showed flows increased by 19,000 acre-feet over 1995BaseMod2. During the dry season, ISOP 2000 showed a 13 percent increase and ISOP 2001 had an 11 percent increase over 1995BaseMod2 flows to the bay. Both ISOP 2000 and ISOP 2001 were similar.

Florida Bay. The 1995BaseMod2 flows to Florida Bay were relatively unchanged in either the annual or monthly values for either the ISOP 2000 or ISOP 2001 operations (SDEIS A-44).

Review of ISOP During 2000 and 2001. Until the modeling database is updated to include the years 2000 and 2001, the RPA targets for the eastern subpopulations would remain unknown. When the database update is complete, the hydro-meteorological conditions can be modeled to produce the RPA targets and compared to the modeled outputs from the ISOP operations for equivalency. Prior to that time, only generalizations about the efficacy of ISOP can be made.

When ISOP was first implemented, the system was in highwater conditions due to Hurricane Irene (October 1999). ISOP operations were able to dry out all the nesting areas of the CSSS by the spring 2000 nesting season. In CSSS Subpopulation A in 2000, drier than average conditions were produced by April, although a late April above-average rainfall disrupted the nesting season. As 2000 progressed, drought conditions persisted during the wet season in south Florida. During the drier-than-average wet season, ISOP operations were able to produce above average stages in NESRS. During the year 2001, all nesting season requirements were met. Although this kind of analysis does not demonstrate that RPA targets were achieved (since the targets are still unknown), it does demonstrate that ISOP operations were effective at producing the kinds of changes indicated by the RPA for prior years.

Alternative 2.

NESRS. The effect of Phase 1 of this alternative (IOP 2b) to the hydrology (water levels in the NESRS) is similar to the 95BaseMod and essentially the same as the No Action Alternative.

Phase 2 for Alternative 2 is IOP2. This plan removes the G-3273 trigger, which under the other alternatives either closes S-333 or routes the discharge (flood discharges) through S-334. With the trigger gone, discharges to NESRS from S-333 via L-29 and the Tamiami Trail culverts can be made when G-3273 is above 6.8 feet. For this alternative, hydrology for the area changes because the discharges through S-333 increase in some years. Annual average ponding depth increased by 0.5 feet during the wettest 15 percent of the time. Removing the trigger on S-333 would provide approximately 115,000 acre-feet/year more water to NESRS. The hydroperiod, as well as the mid-to-lower flow ranges, shows no significant change. CSSS subpopulation E shows a significant increase in the discontinuous hydroperiod in wet years but without an adverse impact to the nesting season consecutive dry days. CSSS subpopulation B shows no significant change. CSSS subpopulation F shows a dramatic increase in the discontinuous hydroperiod in wet years, but has an adverse impact to the consecutive dry days during the nesting season.

WSRS. The effect of Phase 1 of this alternative to the hydrology (water levels in the WSRS) is essentially the same as the No Action Alternative. However, the 6.0 feet criteria at NP-205 would be exceeded six times as opposed to five times for the No Action Alternative.

Phase 2 of this alternative does not change how the S-12s are operated but there is a reduction in the annual volume of flow because more flow is passed down the NESRS side from S-333 via L-29 and the Tamiami Trail culverts (trigger removed). The reduction is about 53,000-

acre feet (339,000 vs. 286,000 acre-feet). The 6.0 feet criteria at NP-205 would still be violated six times as opposed to five for the No Action Alternative.

WCA 1. WCA 1 would not be impacted by Alternative 2. Wet and dry season hydrologic characteristics would not change to any great degree.

WCA 2A and 2B. There is a change in the operation of these areas, as compared to the No Action Alternative and 95BaseMod, which results in higher stages in WCA 2A and WCA 2B. This can be characterized by an increase in stage of about 0.4 to 1.3 feet and having about 63 more weeks of depths greater than 2.5 feet in WCA 2A. An increase in stage of about 0.2 to 0.8 feet and having an increase of more than 450 weeks over the three year period of depths greater than 2.5 feet occurs in WCA 2B.

WCA 3A and 3B. There is an increase in the number of depths greater than 2.5 feet (13 weeks) in the high stage criteria in these areas for Phase 1 of Alternative 2 as compared to the No Action Alternative and 95BaseMod. For Phase 2 of this alternative, operation of S-333 changes with removal of the G-3273 gage trigger; subsequently, there is a slight reduction (4 weeks) in the number of depths greater than 2.5 feet.

Taylor Slough. The effect of Alternative 2 (both phase 1 and 2) on the hydrology of Taylor Slough is much the same as the No Action Alternative and the 95BaseMod.

Lower East Coast Area. The effect of Phase 1 and Phase 2 of Alternative 2 to the hydrology is essentially the same as the 95BaseMod. However, in one cell (R20C28) there was an increase of about 0.75 foot in the stage at the highest 10^{th} percentile in phase 1.

8.5 SMA. The effect of Phase 1 of Alternative 2 on the hydrology (water levels in 8.5 SMA) is the same as the No Action Alternative and 95BaseMod. Phase 2 of Alternative 2 removes the trigger that would limit the operation of S-333 and allows greater discharges to the NESRS. With the 8.5 SMA project completion, the higher water levels in NESRS would not impact the 8.5 SMA. However, without the project, the duration of flooding would increase from about 1 to about 10 percent of time.

Biscayne Bay. The effect of Alternative 2, Phase 1, on Biscayne Bay would be to increase the wet seasons flows by about 20,000 acre-feet/year and the dry seasons flows by about 29,000 acre-feet. The effect of Alternative 2, Phase 2, on Biscayne Bay would be to increase the wet seasons flows by about 24,000 acre-feet/year and the dry seasons flows by about 6,000 acre-feet/year.

Florida Bay. The effect on Florida Bay of Alternative 2, Phase 1 is to reduce flows only slightly during June and July, but Phase 2 of Alternative 2 would reduce the flows by about 10 to 15 percent during the months of June, July and August.

Alternative 3.

NESRS. The effect of Phase 1 of this alternative (IOP 2a) to the water levels in the NESRS is similar to the 95BaseMod and essentially the same as the No Action Alternative.

Phase 2 for Alternative 2 is IOP2. This plan removes the G-3273 trigger, which under the other alternatives either closes S-333 or routes the discharge (flood discharges) through S-334. With the trigger gone, discharges to NESRS from S-333 via L-29 and the Tamiami Trail culverts can be made when G-3273 is above 6.8 feet. For this alternative, hydrology for the area changes because the discharges through S-333 increase in some years. Annual average ponding depth increased by 0.5 feet during the wettest 15 percent of the time. Removing the trigger on S-333 would provide approximately107,000 acre-feet/year more water to NESRS. The hydroperiod, as well as the mid-to-lower flow ranges, shows no significant change. CSSS subpopulation E shows a significant increase in the discontinuous hydroperiod in wet years but without an adverse impact to the nesting season consecutive dry days. CSSS subpopulation B shows no significant change. CSSS subpopulation F shows a dramatic increase in the discontinuous hydroperiod in wet years, but has an adverse impact to the consecutive dry days during the nesting season.

WSRS. Phase 1 of this alternative discharges about 26 percent more flow into the area than Phase 2. Phase 2 of this alternative removes the trigger stage on S-333 and that causes an increase of flows into NESRS and a decrease of flows into the WSRS. However, the 6.0 feet criteria at NP-205 would be violated six times as opposed to five for the No Action Alternative.

WCA 1. WCA 1 would not be impacted by Alternative 3. Wet and dry season hydrologic characteristics would not change to any great degree.

WCA 2A and WCA 2B. There is a change in the operation of these areas, as compared to the No Action Alternative and 95BaseMod, which results in higher stages in WCA 2A and WCA 2B. This can be characterized by an increase in stage of about 0.4 to 1.3 feet and having about 63 more weeks of depths greater than 2.5 feet in WCA 2A. There would be an increase in stage of about 0.2 to 0.8 feet and an increase of more than 450 weeks over the three year period of depths greater than 2.5 feet in WCA 2B.

WCA 3A and WCA 3B. There is an increase in the number of occurrences of depths greater than 2.5 feet (46 weeks) in the high stage criteria in WCA 3A for Phase 1 of Alternative 2 as compared to the No Action Alternative and 95BaseMod. For Phase 2 of this alternative, operation of S-333 changes with removal of the G-3273 gage trigger; subsequently, there is a small reduction (27 weeks) in the occurrence of depths greater than 2.5 feet.

Taylor Slough. The effect of Alternative 3 (both Phase 1 and Phase 2) on the hydrology in the Taylor Slough area is minimal and similar to the No Action Alternative and the 95BaseMod conditions.

East Coast Agricultural Area. The effect of this alternative, Phase 1 and Phase 2, on the hydrology of the subject area is negligible. However, in two cells (R20C28 and C16R29) there were increases of about 0.7 foot in the stage at the highest 10^{th} percentile in phase 1.

8.5 SMA. The effect of Phase 1 of Alternative 3 on the hydrology (water levels in 8.5 SMA) is the same as the No Action Alternative and 95BaseMod. Phase 2 of Alternative 3 removes

the trigger that would limit the operation of S-333 and allows greater discharges to the NESRS. With the 8.5 SMA project completion, the higher water levels in NESRS would not impact the 8.5 SMA. However, without the project, the duration of flooding would increase from about 1 to about 10 percent of time.

Biscayne Bay. The effect of Alternative 3, Phase 1, on Biscayne Bay would be to increase the wet season flows by about 13,000 acre-feet/year; the dry seasons flows would be about the same. The effect of Alternative 3, Phase 2, on Biscayne Bay would be to increase the wet season flows by about 24,000 acre-feet/year and the dry season flows by about 6,000 acre-feet/year.

Florida Bay. The effect on Florida Bay of Alternative 3, Phase 1 (like RPA102) is to reduce flows during June, July, and August by about 10 to 20 percent; Phase 2 of Alternative 3 would reduce the flows by about 10 to 15 percent during the months of June, July and August.

Alternative 4.

NESRS. The effect of Phase 1 of this alternative (IOP 3a) to the water levels in the NESRS is similar to the 95BaseMod and essentially the same as the No Action Alternative.

Phase 2 for Alternative 4 is IOP3. This plan removes the G-3273 trigger and discharges to NESRS from S-333 via L-29 and the Tamiami Trail culverts. For this alternative, hydrology for the area changes because the discharges through S-333 increase in some years. Annual average ponding depth increased by 0.5 feet during the wettest 15 percent of the time. Removing the trigger on S-333 would provide approximately 109,000 acre-feet/year more water to NESRS. The hydroperiod, as well as the mid-to-lower flow ranges, shows no significant change. CSSS subpopulation E shows a significant increase in the discontinuous hydroperiod in wet years but without an adverse impact to the nesting season consecutive dry days. CSSS subpopulation B shows no significant change. CSSS subpopulation F shows a dramatic increase in the discontinuous hydroperiod in wet years, but also a significant adverse impact to the consecutive dry days during the nesting season.

WSRS. Under phase 1 of this alternative, the overall flow to the area is slightly reduced because of the early S-12 closures. In Phase 2, this impact is increased – the stage duration is decreased from 73 to 67%, the wet season stages are reduced by about 0.25 feet, and dry downs (stages < -1 foot) are increased from 172 to 195 events. With the earlier closing of the S-12s, the dry season flows are reduced to 10% of all other alternatives.

The number of predicted failures at NP-205 is five – the same as the No Action Alternatives. Unlike the No Action Alternative, the S-343 (A&B), S-344, and all S-12s would be closed from November 1 until July 15. Also unlike the No Action Alternatives, the complete closure of the WCA 3A outlets into WSRS would have significant impacts within WCA 3A (addressed below).

WCA 1. WCA 1 would be impacted by Alternative 4. An increase of 0.2 foot in the regulatory schedule resulted in high frequency of depths greater than 2.5 feet.

WCA 2A and WCA 2B. There is a change in the operation of these areas, as compared to the No Action Alternative and 95BaseMod, which results in higher stages in WCA 2A and WCA 2B. This can be characterized by an increase in stage of about 0.4 to 1.3 feet and having about 63 more weeks of depths greater than 2.5 feet in WCA 2A. An increase in stage of about 0.2 to 0.8 feet and having an increase of more than 450 weeks of depths greater than 2.5 feet in WCA 2B.

WCA 3A and WCA 3B. The combination of earlier closure of the S-12s and not passing water to L-31N dramatically increases the stages in the south and the south central areas of WCA 3A. For Phase 1, the depths greater than 2.5 feet increase by about 90 weeks for the south region (only RPA102 was worse) and by 72 weeks in the south central region (as compared to the No Action Alternative and the 95BaseMod). For Phase 2, the depths greater than 2.5 feet increase by about 24 weeks for the south region and by about 37 weeks in the south central region (over the No Action Alternative and the 95BaseMod). Most of the highest stage increases (0.5 to 1.0 foot) occurred in wet years like 1995. For WCA 3B, the stage increases were not significant, however the depths greater than 2.5 feet increased from 2 to 6 weeks for both Phase 1 and 2 (over the No Action Alternative and the 95BaseMod).

Taylor Slough. The effect of Alternative 4 (both Phase 1 and Phase 2) on the hydrology in the Taylor Slough area is minimal and similar to the No Action Alternative and the 95BaseMod conditions.

East Coast Agricultural Area. Alternative 4 shows no significant pattern changes to the stages in the subject area.

8.5 SMA. The effect of Phase 1 of Alternative 4 on the hydrology (water levels in 8.5 SMA) is the same as the No Action Alternative and 95BaseMod. Phase 2 of Alternative 4 removes the trigger that would limit the operation of S-333 and allows greater discharges to the NESRS. With the 8.5 SMA project completion, the higher water levels in NESRS would not impact the 8.5 SMA. However, without the project, the duration of flooding would increase from about 1 to about 10 percent of time.

Biscayne Bay. The effect of Alternative 4, Phase 1, on Biscayne Bay would be to increase the wet season flows by about 14,000 acre-feet/year and the dry season flows would be about the same. The effect of Alternative 4, Phase 2, on Biscayne Bay would be the to increase the wet season flows by about 26,000 acre-feet/year and the dry season flows by about 9,000 acre-feet/year.

Florida Bay. The effect on Florida Bay of Alternative 4, Phase 1 is to reduce flows during June, July, and August by about 10 to 25 percent; Phase 2 of Alternative 4 would reduce the flows by about 10 to 15 percent during the months of June, July and August. With the earlier closures of the S-12s and not passing S-333 releases to L-31N, the Phase 1 flows to Florida Bay are significantly less in several months when compared to Alternative 1. Phase 2 flows to Florida Bay are slightly more than Alternative 1 during October and November, but slightly less than Alternative 1 in June and July. The Phase 1 and 2 flows to Whitewater Bay, via Shark River Slough, are less than Alternative 1 during November through February. These

areas have already been subject to reduced flows due to the implementation of ISOP; closing on November 1 would further increase the adverse impact on salinity.

Alternative 5.

NESRS. Alternative 5, Phase 1, is similar to the No Action Alternative with regard to impacts on NESRS, except there is about a 0.1 foot decrease in stages for about 30 percent of the time. One of the primary differences between this alternative and Alternatives 2, 3, and 4 was allowing S-12D to remain open all year. In Phase 2 (as in the other alternatives), the constraint at G-3273 is removed. Annual average ponding depth increased by 0.5 feet during the wettest 15 percent of the time. Removing the trigger on S-333 would provide approximately 103,000 acre-feet/year more water to NESRS. The hydroperiod, as well as the mid-to-lower flow ranges, shows no significant change.

Unlike the No Action Alternative, Alternative 5 also changes the pump criteria in L-31N to improve the hydrologic characteristics for the eastern sparrow regions. This is most noticeable in CSSS subpopulation F which shows a dramatic increase in the discontinuous hydroperiod in wet years, but indicates a less adverse impact to the consecutive dry days during the nesting season than in Alternatives 2,3, and 4. CSSS subpopulation E shows a significant increase in the discontinuous hydroperiod in wet years without an adverse impact to the nesting season consecutive dry days. CSSS subpopulation B shows no significant change.

WSRS. Alternative 5 would be similar to the No Action alternative with regard to impacts to WSRS. The proposed closing schedule for the S-12 structures is the same for Alternative 5 as with the No Action Alternative. The number of predicted failures in the 31year period of record at NP205 is the same (five) as with Alternative 1 and RPA130.

WCA 1. WCA 1 would not be impacted by Alternative 5. Neither wet nor dry season hydrologic conditions would change from Alternative 1 or the 95BaseMod.

WCA 2A and WCA 2B. Alternative 5 does not significantly change the hydrologic characteristics of either WCA 2A or WCA 2B from Alternative 1 or the 95BaseMod.

WCA 3A and WCA 3B. The preliminary stage duration curves indicate that Alternative 5, Phase 2, would slightly increase water levels (about 0.2 foot) with an increase in depths greater than 2.5 feet of 25 weeks out of the 1,612 weeks modeled in WCA 3A over the No Action Alternative and Phase 1. However, the total number of weeks is still less than or equal to the 95BaseMod condition. Similarly, a stage increase of about 0.3 feet (closer to NSM stages) without significant increase to depths greater than 2.5 feet occurred in WCA 3B. The final model runs are expected to show a decrease in water levels from the No Action Alternative and Phase 1.

Taylor Slough. The effect of Alternative 5 is essentially the same as with the No Action Alternative.

East Coast Agricultural Area. Alternative 5 shows no significant pattern changes to the stages in the subject area.

8.5 SMA. The effect of Alternative 5 is the same as with the No Action Alternative on this area.

Biscayne Bay. The effect of Alternative 5 is negligible when compared to the No Action Alternative.

Florida Bay. The effect of Alternative 5 is similar to the No Action Alternative on this area but has about 10 percent less flow during the months of June, July, and August.

Alternative 6.

Alternative 6 is essentially the same as Alternative 5 with the addition of a 240 acre seepage reservoir at S-332B to supplement the existing 160 acre reservoir.

NESRS. There are no proposed changes that would affect NESRS; Alternative 6 is expected be similar to the No Action alternative with regard to impacts on NESRS. In Phase 2 (as in the other alternatives), the constraint at G-3273 would be removed. However, changes would occur with regard to the amount of overflow potentially impacting the CSSS subpopulations E and F. The increase in size of the seepage reservoir would significantly reduce, weir overflow from the water pumped from S-332B.

WSRS. There are no proposed changes that would affect WSRS; Alternative 6 is expected to be similar to the No Action Alternative with regard to impacts to WSRS. The proposed closing schedule for the S-12 structures is the same for Alternative 6. As with the No Action Alternative, this schedule would attempt to dry the area out by March 1, but five periods of less than 60 days below 6.0 feet at NP-205 are predicted.

WCA 1. There are no proposed changes to the operations of WCA 1; it is not expected be impacted by Alternative 6.

WCA 2A and WCA 2B. There are no proposed changes to the operations of WCA 2A or 2B; they are not expected be impacted by Alternative 6.

WCA 3A and WCA 3B. There are no proposed changes to the operations of WCA 3A or 3B; they are not expected be impacted by Alternative 6.

Taylor Slough. The effect of Alternative 6 is expected to be essentially the same as with Alternative 5.

East Coast Agricultural Area. Alternative 6 should show no significant pattern changes to the stages in the subject area.

8.5 SMA. The effect of Alternative 6 would be the same as Alternative 5 in this area.

Biscayne Bay. The effect of Alternative 6 would be negligible when compared to Alternative 5.

Florida Bay. The effect of Alternative 6 is the same as Alternative 5 in this area.

Alternative 7.

Because Alternative 7 represents a dual mode operation (i.e. changing between two L-31N canal levels depending on hydrologic conditions), it could not be modeled directly using the SFWMM version 3.8. To evaluate the results of this alternative, the model was run in both modes (no passing of flood flows down L-31N with higher pumping triggers and passing of flood flows down L-31N with lower pumping triggers). These two model runs, termed ALT 7a and ALT 7b, represent the range of potential impacts associated with either mode. Performance measures that show both wet and dry year effects can be further evaluated knowing the dry years would be more indicative of model run termed ALT 7a and the wet years would be more indicative of model run termed ALT 7b. The actual benefit or impact would be represented between the two extremes in some areas, or be more like only one extreme in other areas. For example, in the WCA 3A the true impact would be the same as ALT 7b (since water would be moved to L-31N and no other changes would effect this region). For another example, the true impact in the eastern sparrow regions would more likely be the averaged effect of both ALT 7a and ALT 7b.

It should be noted that the model runs termed ALT 7a and 7b do not represent a two-phase implementation, but rather an attempt to provide the bounds of effects of the dual mode operation of L-31N in Alternative 7. In many areas, there is little difference between the two model runs that, together, represent the effects of the range of operations in Alternative 7.

NESRS. Alternative 7 is similar to the No Action Alternative (ISOP 2001) in regard to impacts on NESRS (SDEIS A-62); however, Alternative 7 has 5 fewer dry downs over the 31 years compared to the No Action Alternative (SDEIS A-63). Alternative 7 supplies about 133,000 acre-feet/year into NESRS whereas the No Action Alternative and RPA02 supply 126,000 and 210,000 acre-feet/year, respectively (SDEIS A-87). Although the amount delivered into NESRS is less than RPA02, Alternative 7 would not cause the significant flooding impacts that could occur in RPA02 in the 8.5 SMA.

No significant differences are shown between Alternative 7 and the No Action Alternative in CSSS subpopulations B, D, and E (SDEIS A-72 to A-75 and A-78 to A-83). In those cases, Alternative 7 meets or exceeds the requirements of RPA02. In subpopulations C and F (SDEIS A-75 to A-77 and A-84 to A-86), Alternative 7 average stages, durations, and discontinuous hydroperiod of ALT 7a and ALT 7b would be slightly less than the No Action Alternative but still meet or exceed the RPA02 requirements.

WSRS. Alternative 7 would result in slightly wetter conditions, compared to the No Action alternative, with regard to impacts to WSRS (SDEIS A-64 and A-65). Although the closing schedule for the S-12 structures is similar to the No Action Alternative, about 36,000 acre-feet more water would be passed through the region from WCA3A (SDEIS A-87).

The stages and stage duration of Alternative 7 (both ALT 7a and ALT 7b) are similar to the No Action Alternative and show conditions drier than those of RPA02 (SDEIS A-66 to A-71), which, in this indicator region, is an improvement. The number of predicted nesting failures in the 31-year period of record at NP205 is the same (five) as under both the No Action Alternative and RPA02.

WCA 1. Alternative 7 would not impact WCA 1 (SDEIS A-48 and A-49). Neither wet nor dry season hydrologic conditions would change from the No Action Alternative.

WCA 2A and WCA 2B. Alternative 7 would not significantly change the hydrologic characteristics of either WCA 2A or WCA 2B from the No Action Alternative (SDEIS A-50 to A-53).

WCA 3A and WCA 3B. The preliminary stage duration curves indicate that Alternative 7, would be similar the No Action Alternative for ALT7b which represents moving water to L-31N from WCA 3A during high stages (SDEIS A-54 to A-57). Without the moving of water to L-31N, there would be an increase in the number of weeks of high stages in WCA 3A; however there would likely be a decrease in the weeks of high stages as shown by ALT 7b. In WCA 3B, there is likely to be a slight reduction in the number of weeks of high stages (SDEIS A-58 and A-59).

Taylor Slough. The effect of Alternative 7 is essentially the same as with the No Action Alternative (SDEIS A-60 and A-61).

East Coast Agricultural Area. SFWMM analysis of Alternative 7 shows no significant pattern changes to the stages in the subject area (SDEIS A-92). Alternative 7 shows no increases in the peak stage values. However, comments received on behalf of the Greater Homestead/Florida City Chamber of Commerce (see Appendix E, comments HFC-2) indicated that operating levels for structures serving the L-31N canal would be raised from 0.2 to 0.5 feet above current operating levels, which could lead to higher water tables in the area adjacent to the canal. As previously mentioned, the SFWMM predicts changes over 2-mile square grids, so localized higher ground water tables would not necessarily be evident. Based on this information, water levels in these areas could be higher with Alternative 7 than with ISOP 2001 during high rainfall periods.

8.5 SMA. The effect of Alternative 7 is the same as with the No Action Alternative in this area (SDEIS A-91).

Biscayne Bay. The effect of Alternative 7 is negligible to Biscayne Bay areas, when compared to the No Action Alternative, except for the South Bay region (SDEIS A-88). In South Bay, there is likely to be a slight decrease (comparred to the No Action Alternative)of about 26,000 acre-feet/year in surface flows. However, this would still represent more freshwater flow than the 1995 Base condition.

Florida Bay. The effect of Alternative 7 would be similar to the No Action Alternative (SDEIS A-89 and A-90). ALT 7a shows less flow during all months, whereas ALT 7b shows

about the same flow for all months. Considering the average of ALT 7a and ALT 7b, there is likely to be only a slight reduction in flows toward Florida Bay.

Alternative 7R (Recommended Alternative)

Alternative 7R, like Alternative 7, has a dual-mode operation in L-31N; hence trigger levels at key structures vary according to whether or not water is being passed from WCA 3A into L-31N. Although some structure trigger levels in South Dade are somewhat higher than the Existing condition and slightly higher than the 1995 Base, more storage (in the form of seepage reservoirs) is provided in Alternative 7R. At the completion of construction, no overflow would be passed from the seepage reservoirs to the ENP.

In Alternative 7R, pre-storm drawdown would be similar to Alternative 7, except for operations related to other than named events. For those events, the SFWMD would monitor antecedent conditions, groundwater levels and rainfall. If these conditions indicated a strong likelihood of flooding, SFWMD would make a recommendation to the Corps to initiate pre-storm drawdown or otherwise alter system-wide operations from those contained in the Table 2.11.

The Chairman of the Miccosukee Tribe of Indians of South Florida or his designated representatives, would monitor the conditions in WCA 3A and other tribal lands and predicted rainfall. If the Tribe determines these conditions indicate jeopardy to the health or safety of the Tribe, the Chairman would make a recommendation to the Corps to change the operations of the S-12 structures or other parts of the system. The Corps would review the data, advise appropriate agencies of the conditions, and the District Commander would personally consult with the Chairman prior to making a decision whether to implement changes to the S-12 operations.

It is recognized that new technical information may be developed as this plan is implemented and that observed results may differ from predicted results. Considering this, it may be necessary to adjust operations to address the new information or observed results to achieve better performance for environmental restoration and protection, to ensure the health, safety, and well being of the general public, and ensure affected individuals are protected.

NESRS. Alternative 7R is expected to be similar to the No Action Alternative with regards to impacts on NESRS. Pumping at the newly constructed S-356 structure would be limited to values that do not impact residents of the 8.5 Square Mile Area. The intent is to pump excess water in L-31N, north of G-211, into NESRS.

The stages in CSSS subpopulation E and F are expected to easily exceed the requirements of the RPA. The effect of pumping into seepage reservoirs from S-332D could slightly decrease the stages in the CSSS subpopulation C and D. However, if an increase in stages in subpopulation C is desired by the FWS, culverts could be used to increase the stages in L-31W thereby improving the conditions subpopulation C.

WSRS. Alternative 7R may result in some increases of flow into WSRS due to the operations of the WSE Lake Okeechobee schedule and the operational considerations of Miccosukee

Tribal recommendations; however, no increase in the number of nesting season failures of the CSSS subpopulation A are expected.

WCA 1. Alternative 7R is not expected to impact WCA 1.

WCA 2A and WCA 2B. Alternative 7R is expected to impact WCA 2A and WCA 2B in the same manner as Alternative 7 and the No Action alternative.

WCA 3A and WCA 3B. Alternative 7R could have a slight increase over existing conditions and be similar to 1995 Base, however the effect of opening the S-12s as a result of Tribal considerations should lesson potential impacts.

Taylor Slough. Under Alternative 7R, the effect of pumping into seepage reservoirs from S-332D could slightly decrease the stages in Taylor Slough. Should it become necessary, as determined by the ENP, culverts could be used to increase the stages in L-31W thereby improving the conditions in Taylor Slough.

East Coast Agricultural Area. Canal stages under Alternative 7R would be the same as with Alternative 7. As with Alternative 7, operating levels for structures serving the L-31N canal would be raised from 0.2 to 0.5 feet above current operating levels, which could lead to higher water tables in the area adjacent to the canal. However, the availability of the S-332B storage capacity, the S-356 pump station, and S-332C seepage reservoir would add flexibility to the water managers to minimize potential flooding during high rainfall events. The effects of combining the higher structure trigger levels with more storage area are difficult to predict. Therefore, Alternative 7R operations could be slightly modified if new technical information indicates that conditions in some areas are worse than anticipated.

8.5 SMA. Alternative 7R is anticipated to be similar to 1995 Base conditions since the pumping limitation at G-3273 is still used to restrict releases into NESRS. Operations of the S-356 pump would be restricted so that no increases in highwater stages are expected.

Biscayne Bay. With the higher trigger levels in Alternative 7R that effect releases into Biscayne Bay, it is anticipated that flows would be reduced (compared to existing conditions) in both the central and southern parts of the bay.

Florida Bay. The effect of the increased seepage reservoirs in L-31N are expected to reduce the flows to Florida Bay during the wet season months (July through November) as compared to the 1995 Base and the existing conditions.

4.4 Water Quality

Passage of the Everglades Forever Act (EFA) in 1994 required the establishment of a numeric phosphorus criterion for the Everglades Protection Area (EPA). Section 4(e) of the EFA, indicates that the phosphorus criterion would be established based on research results targeted at numerically interpreting the Class III narrative nutrient criterion necessary to meet state water quality standards in the EPA. The phosphorus criterion will be 10 parts per billion

(ppb) in the EPA in the event that DEP does not adopt by rule a research-established criterion by December 31, 2003.

The method of determining compliance with the phosphorus criterion in ENP is specifically indicated in section 4(e):

> *For the Everglades National Park (Park) and the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge), the method for measuring compliance with the phosphorus criterion shall be in a manner consistent with Appendices A and B, respectively of the settlement agreement dated July 26, 1991, entered in case No. 88-1886-Civ-Hoeveler, United States District Court for the Southern District of Florida, that recognizes and provides for incorporation of relevant research.*

Appendix A of the settlement agreement refers to the phosphorus limits for the combined inflow to Shark River Slough and the phosphorus limits for the combined inflow to Taylor Slough (S-332 and S-175) and the Coastal Basins (S-18C) as attachments I and II, respectively

As required by Section 9(k) of the EFA, the SFWMD obtained a permit (Non-ECP permit) from the DEP to operate and maintain water management structures within the control of the District which discharge into, within, and from the EPA and are not included in the Everglades Construction Project. The Non-ECP permit includes structures S-332, S-175, and S-18C.

The EFA further states in its' section 10 that by December 31, 2006, the water delivered to the EPA will achieve compliance with all state water quality standards, including the phosphorus criterion, in all areas of the EPA.

The SFWMD has used the settlement agreement as a basis for monitoring total phosphorus concentrations in the C-111 Basin. The results of the monitoring effort are used to document compliance with state water quality standards for discharges to Taylor Slough and the Coastal Basins. The Non-ECP permit requirements are used for all other water quality parameters that have numeric Class III criteria as stated in Section 62-302.530, F.A.C.

Settlement Agreement Requirements

There are specific requirements in the settlement agreement governing water quality compliance issues associated with total phosphorus. The relevant parts for the C-111 basin are as follows:

- The state parties (DEP and SFWMD) must take such action as is necessary so that waters delivered to ENP achieve state water quality standards, including Class III standards, by December 31, 2006.

- The state parties commit to achieving interim phosphorus concentration limits and levels by October 1, 2003, and long-term limits and levels by December 31, 2006.

Both an interim and long-term limit is specified for Shark River Slough. However, only a long-term limit is specified for Taylor Slough and the Coastal Basins.

- The long-term concentration limit for Taylor Slough (S-332 and S-175) and the Coastal Basins (S-18C) is 11 ppb. Compliance with the long-term total phosphorus concentration limits and levels for ENP is determined in accordance with the methodologies and procedures established in the settlement agreement, and its' Appendix A. If a conflict arises in the methods or procedures between the agreement and Appendices, the Appendices prevail. The agreement further stipulates how the USACE is to conduct matters relating to water quality issues associated with any new discharges to the park resulting from the construction of new structures, as follows:

- The USACE is required to apply to FDEP for stormwater management permit(s) pursuant to Section 373.416, F.S., for the construction and operation of new structures which may affect ENP or the Refuge, and shall comply with reasonable permit terms and conditions relating to the abatement of the water quality problems addressed in the agreement.

- New structures to be designed and constructed by the USACE shall be designed and constructed in accordance with the agreement.

- Future projects designed by the United States that affect ENP or the Refuge shall consider the environmental and water quality commitments set forth in the settlement agreement. Attachment II of Appendix A of the settlement agreement discusses the discharge limits and OFW standards for Taylor Slough and Coastal Basins. This section defines how the total phosphorus compliance calculations are made, provides direction on adding new structures to the calculation, and states:

- The basin flow is defined as the total flow through structures S-332, S-175, S-18C, plus any new release points from this basin in the future. All total phosphorus data should be sampled on the same day since a spatial average from the data collected at each structure is used for a compliance calculation. All new structures should also have a consistent monitoring regime to allow for compliance calculations to be made. This intent was made clear in the Fall of 2000, when the Technical Oversight Committee (TOC) indicated that monitoring activities needed to be initiated at the S-355A and S-355B structures discharging into ENP through northeast Shark River Slough. These structures, and the S-332D structure, are not directly under the control of the SFWMD, yet the water quality monitoring program must conform to settlement agreement requirements for compliance calculations.

The S-332B emergency overflow weir has overtopped on two occasions since its construction in April 2000. The overflow weir is located on the southwestern side of the detention basin and is approximately 1500 feet in length. These overflows were the result of a 1.7 inch rainfall event in September and a 10.5 inch rainfall event in October of 2000. The overflow data from grab samples show no detects of total mercury or pesticides. During the September event, there did not appear to be a relationship between this storm event and excess delivery of total phosphorus. However, during the larger storm in October, a large load of total

phosphorus was transported at S-332B Weir and S-332D into Taylor Slough. The detention basins did not provide much treatment for nutrients at lower levels; however, during the large October storm event, the detention area appeared to provide some removal due to particulate settling.

ISOP 2000 and ISOP 2001

ISOP 2000 operated S-332B at 325 cfs year round. With ISOP 2001, the station is designed to pump 325 cfs from June through January, and 125 cfs from February through March to maintain head water levels between 4.7 and 4.2 feet into a 160-acre seepage reservoir. If flows greater than 120 to 300 cfs (depending on the surrounding water levels) were pumped from the S-332B structure, the water would eventually flow over the weir of the seepage reservoir and enter the ENP as overland flow. It is not believed at this time that a violation of the settlement agreement levels would occur due to the overflows with either ISOP alternative. This is based on the overflow data (September and October 2000 events). The settlement agreements for Taylor Slough are based on a flow-weighted average for all inflow points into the Taylor Slough region. As shown in Table 4.1, inclusion of the S-332B weir discharges of September and October 2000 (during ISOP 2000 operations) into the Taylor Slough total phosphorus concentration calculations raised the flow-weighted average by a maximum of 0.8 ppb, from 8.4 ppb to 9.2 ppb (for the period April 2000 to March 2001) (Mark Shafer, personal communication). Given that higher than average flows occur at S-332D and S-18C during August, September, and October, the impact of the October 2000 discharges from S-332B weir on the 12 month moving flow-weighted average total phosphorus concentration for Taylor Slough would be expected to be less than the maximum 0.8 ppb indicated.

Table 4.1. Long-Term (12-month) Flow-Weighted Average Total Phosphorus Concentration for Taylor Slough Inflows With and Without S332B Weir Inflows.

12-Month Calculation Period		S18C+S174+S332D	S18C+S174+S332D +S332B Weir
Beginning	**Ending**	**Flow-Weighted Average Total Phosphorus Concentrations (ppb)**	**Flow-Weighted Average Total Phosphorus Concentrations (ppb)**
September 99	August 00	8.6	8.6
October 99	September 00	8.5	8.5
November 99	October 00	8.1	8.7
December 99	November 00	8.1	8.7
January 00	December 00	8.1	8.7
February 00	January 01	8.3	9.0
March 00	February 01	8.3	9.1
April 00	March 01	8.4	9.2
May 00	April 01	8.3	9.2
June 00	May 01	8.3	9.1
July 00	June 01	8.3	9.1

Alternatives 2, 3, and 4.

Alternatives 2, 3, and 4 would pump 325 cfs year round to maintain water levels between 4.5 and 4.0. The alternatives have the option of increasing the pumping up to 500 cfs during the wet season to lower pressure on retaining excess water in the WCAs. Impacts to water quality would be similar to those of the No Action alternative.

Alternative 5.

Alternative 5 would increase pumping to 500 cfs from July 16 to November 30, which would result in an overflow of the S-332B retention basin in excess of those from Alternatives 1, 2, 3, and 4. Even though Alternative 5 would have greater overflow than the other alternatives, it is not believed that this would result in a violation of the settlement agreement levels.

Alternative 6.

Alternative 6 would also increase pumping to 500 cfs from July 16 to November 30. Alternative 6 would attenuate water quality impacts from the increased pumping and subsequent overflow by adding an additional 240 acre seepage reservoir to work in conjunction with the existing 160 acre reservoir. The additional seepage reservoir would help reduce weir inflows and provide additional treatment area.

Alternative 7

Alternative 7 would not result in adverse impacts to water quality. With Alternative 7, S-332B would pump 250 cfs from June through February, but only when this pumping would not cause overflow into ENP. If it is determined that overflow would occur, the pumping volume would be adjusted. Alternative 7 would attenuate water quality impacts from the increased pumping and subsequent overflow by adding an additional 240-acre seepage reservoir to work in conjunction with the existing 160-acre reservoir. The additional seepage reservoir would help reduce weir inflows and provide additional treatment area. Over the 31-year period of record, there were 44 tropical storms that could have triggered the pre-storm operations, and then only if the canal stage, groundwater, surface water, or antecedent rainfall warranted. As indicated by the overflow events of September and October 2000, it is unlikely that these events would violate the flow-weighted average for total phosphorus concentrations entering Taylor Slough.

Alternative 7R (Recommended Plan).

Alternative 7R would have a water quality impact similar to Alternative 7. However, once Alternative 7R is fully constructed, there would be less likelihood of discharge into ENP due to the additional flood storage capacity at S-332C.

4.5 Flood Control

L-31N is on the east side of the 8.5 SMA and the ENP is to the north and west. For ISOP 2000 and ISOP 2001 (No Action Alternative), the water surface elevation in the eastern portion of this area would be above ground level about one percent of the year for the 31-year simulation period based on the Rocky Glades Marl Gage G-596. The 95BaseMod2 condition simulation indicated about the same condition.

The effect of Phase 1 of Alternatives 2, 3, and 4 on the hydrology (water levels in 8.5 SMA) is the same as ISOP 2000 (Alternative 1) and ISOP 2001 (No Action). Phase 2 of Alternatives 2, 3, and 4 are also expected to have no adverse impact on flooding in the area after the 8.5 SMA Project is constructed. Without the mitigation feature, surface flooding (as indicated by G-596) would increase from 1 to 10 percent of time. Groundwater levels would be increased over a somewhat longer period. To the east of L-31N and C-111, the peak stage indicators in several cells show that the 95BaseMod condition and all of the alternatives were nearly equivalent with no pattern of being worse or better. Only cell R10C25 indicated a longer duration of root zone flooding (from 48% to 56% of time); however, neither the peak stage nor the stage at the highest 10^{th} percentile were worsened.

The effect of Alternative 7 on the hydrology (water levels in 8.5 SMA) is the same as the No Action Alternative. To the east of L-31N and C-111, the peak stage indicators in several cells show that the 95BaseMod2 condition and all of the alternatives were nearly equivalent with no pattern of being worse or better. However, additional data showed that higher L-31N canal stages with Alternative 7, when compared to ISOP 2001, could lead to higher water tables in the adjacent areas during heavy rain events.

Additional flood storage capacity at S-332C and S-332-D (under the C-111 and MWD projects) would enable Alternative 7R to reduce the potential for the higher canal stage which could lead flooding in excess of existing levels. The effect of Alternative 7R on the hydrology (water levels in 8.5 SMA) is anticipated to be higher than existing conditions but similar to 1995 Base conditions. However, the effects of combining higher structure trigger levels and more storage area are difficult to predict. Therefore, Alternative 7R operations could be slightly modified if new technical information indicates conditions in some areas are worse than anticipated.

It should be noted that model runs do not have the ability to use daily forecasts as inputs. In a real-time application of the alternatives, water managers would use forecasts to help guide day-to-day decisions. The daily use of forecasts should result inflexibility and better operational decisions than those that are made by the model. Furthermore, if there are model prediction errors in canal stages, the errors would not affect the real-time operations, since the water managers would be using actual data rather than predicted values.

4.6 Wetlands

The alternatives would cause similar types of impacts on wetlands. In general, wetlands in NESRS, the Rocky Glades, and the western marl prairies are expected to benefit from the

restoration of more natural hydroperiods, whereas increased flooding in southern WCA 3B and WCA 2A may contribute to negative wetland impacts. Wetland impacts associated with each of the project alternatives are essentially the same as vegetative community impacts that are discussed in more detail in the following section.

4.7 Vegetation

NESRS

ISOP 2000 (Alternative 1), ISOP 2001 (No Action), and Phase 1 operations of Alternatives 2, 3, 4, and 5 are likely to have similar effects on water levels and vegetation in NESRS. All of these operational plans either close the S-333 structure or reroute discharges through the S-334 structure when water levels at G-3273 exceed 6.8 feet. Therefore, any changes in NESRS hydroperiods and resulting shifts in vegetative communities would be similar under each of these alternatives. Each of these operational plans also would produce hydrological conditions very similar to 95BaseMod conditions, with similar effects on vegetative communities. Removal of the G-3273 trigger under Phase 2 of Alternatives 2, 3, 4, and 5, as well as Alternative 6 allow discharges via S-333 when water levels exceed 6.8 feet at G-3273. Discharges to NESRS through S-333 would increase when water levels at G-3273 surpass 6.8 feet.

Increases in ponding depths and hydroperiod duration associated with Phase 2 of the various alternatives should benefit vegetative communities in NESRS and the northeastern marl prairies by restoring longer and more natural hydrologic regimes to the area. Over-drainage in the peripheral wetlands along the eastern flank of NESRS has resulted in shifts in community composition, invasion by exotic woody species, and increased susceptibility to fire (USFWS 1999a,b). Increases in ponding depths and hydroperiod duration associated with Phase 2 operations should help to reverse these trends by reducing tree island susceptibility to fire, restoring deeper water habitats required for slough/open water marsh communities, and reducing the amount of available habitat for less flood tolerant exotic tree species.

WSRS and Western Marl Prairies

The WSRS area is primarily influenced by S-12 structure operations. Consequently, any changes in WSRS hydroperiods and resulting shifts in vegetative communities would be similar under each of the alternatives. Each of the alternatives would result in a similar reduction of annual flooding duration in WSRS and the western marl prairies relative to 1995 Base conditions. All of the alternatives should have a similar beneficial effect on the western short-hydroperiod marl prairies by producing shorter hydroperiods that would benefit marl prairie vegetation. The westernmost S-12 structures (A, B, and C) would be closed November 1, January 1, and February 1, respectively. S-12D, which has the least impact of the western sparrow habitats, would remain open year round to allow excess water to leave the WCA areas.

WCA 2

In comparison to 1995 Base conditions, all of the alternatives could produce substantial increases in the duration of high stage events in WCA 2B. Historically, WCA 2B has

suffered from lowered water levels that resulted in heavy melaleuca infestations throughout the area (USACE 1999a). According to the FWC, the majority of melaleuca stands have been eliminated from WCA 2B. Increases in the duration of high stage events in WCA 2B could to benefit vegetative communities by preventing re-establishment of melaleuca in the area. In recent years, WCA 2B has suffered from extreme high water conditions. In the past, high water levels have severely damaged native willow communities that provide nesting and roosting for snail kites and wading birds. Closing of the S-12 structures with all alternatives could exacerbate this problem. If the duration of inundation were too high, adverse impacts could occur to vegetation and tree islands in the area.

Alternatives 2 and 3 would produce very similar hydrological conditions in WCA 2. Average annual flooding duration and ponding depths are not significantly different for the two alternatives. These alternatives reduce flooding impacts to WCA 3A by holding back water in WCA 2A. In comparison to 95BaseMod conditions, Alternatives 2 and 3 produce substantial increases in the frequency and depth of high water events in WCA 2A. Past increases in flooding in WCA 2A have resulted in the drowning of tree islands, loss of long-hydroperiod wet prairie communities, and loss of sawgrass marshes along sloughs (USACE 1999a). Increases in flooding associated with the alternatives are likely to have an adverse impact on tree islands and other wetland communities in WCA 2A. Adverse affects may include loss of remnant tree islands, conversion of short hydroperiod wetlands to low-diversity sawgrass-cattail marshes, and conversion of long hydroperiod marshes to open water slough.

Alternative 4 would have an even greater adverse impact on WCA 2. Alternative 4 actions include closing the S-12 and S-343/344 structures from November 1 to July 15, which would cause additional water retention in WCA 2A and would lead to loss of more tree islands, wet prairie communities, and other habitat.

Alternatives 5 and 6 (as well as the No Action alternative), close one of the S-12 structures (S-12A) earlier than Alternatives 2 and 3, the same with S-12B and S-12C, and do not close S-12D. The result of this would be less adverse impact from ponding on WCA 2A than with Alternatives 2, 3, and 4.

Alternative 7 and 7R would be similar to the No Action Alternative with regard to impacts to vegetation. Although there would be less ponding than with some of the other alternatives, vegetation could be adversely affected.

Water Conservation Area 3

Alternative 2-Phase 2 (IOP 2) and Alternative 3-Phases 1 (IOP 2A) and 2 (IOP 2) would result in a very small increase in hydroperiod duration from the 300 to 330 day range to the 330 to 365 day range for one cell in WCA 3A and one cell in WCA 3B, relative to Alternative 2-Phase 1 (IOP 2B). These same operations would also increase average annual ponding depth classes from the 0.5 to 1.0 feet range to the 1.0 to 2.0 feet range in a few cells in the central and eastern portions of WCA 3A and over a large portion of the lower two-thirds of WCA 3B. Compared to 1995 Base conditions, Alternative 2-Phase 2 and Alternative 3-Phases 1 and 2 would produce similar conditions in WCA 3A and greater average ponding depths in 3B. Conversely, Alternative 2-Phase 1 would produce conditions similar to

95BaseMod in WCA 3B and slightly dryer conditions in northeastern WCA 3A. Alternative 4 would have an adverse impact on WCA 3A. Higher water levels caused by the early closure of the S-12 structures could impact vegetation on the southern portion of the WCA. For example, if the S-12 structures had been closed on November 1 in 1999, the water elevations would have been almost two feet higher than were realized. This could have had a detrimental effect on vegetation. ISOP 2000 (Alternative 1), ISOP 2001 (No Action alternative), Alternative 5, and Alternative 6 would provide hydrologic relief to NESRS and WSRS without the excessive ponding in WCA 3A of Alternative 4. S-12D would remain open and provide an important conduit for excess rainfall inundating WCA 3A during wet years without causing higher water elevations in the western sparrow habitat.

Currently, the two most significant causes of habitat degradation in WCA 3A are flood damage to tree islands in the northeastern and southwestern portions of 3A and the loss of peat soils, marshes, and tree islands in the northern portions of WCA 3A as a result of drought conditions and resulting wildfires. Although WCA 3B is drier than pre-drainage conditions, tree islands have remained largely unimpacted in this area. Alternatives 1, 2, 3, 5, and 6 would not have a significant effect on vegetation throughout the majority of WCA 3A, with the exception of slightly drier conditions in extreme northeastern 3A under Alternative 1 and Alternative 2-Phase 1. These drier conditions may provide some relief for tree islands that have experienced flood damage in this area. The increases in ponding depths in WCA 3B under Alternatives 1, 2, 3, 5, and 6 may provide some relief for over drained areas in southeastern 3B. Increases in ponding depths in the remainder of 3B under these same alternatives may have negative effects on some tree islands as a result of increased flooding. Alternative 4 would also increase ponding depths in WCA 3B, but to a greater degree than the other alternatives.

Alternative 7 and Alternative 7R would provide hydrologic relief to NESRS and WSRS without excessive ponding in WCA 3A. S-12D would remain open and provide an important conduit for excess rainfall inundating WCA 3A during wet years without causing higher water elevations in the western sparrow habitat. Currently, the two most significant causes of habitat degradation in WCA 3A are flood damage to tree islands in the northeastern and southwestern portions of 3A and the loss of peat soils, marshes, and tree islands in the northern portions of WCA 3A as a result of drought conditions and resulting wildfires. ISOP 2000, ISOP 2001, Alternative 7, and Alternative 7R would not have adverse effects on vegetation throughout WCA 3A.

Although WCA 3B is drier than pre-drainage conditions, tree islands have remained largely un-impacted in this area from flooding. ISOP 2000, ISOP 2001, Alternative 7, and Alternative 7R would not have adverse effects on vegetation throughout WCA 3B.

Eastern Marl Prairies and Taylor Slough

Although Alternative 2, Phase 1 (IOP 2A) removes a berm in front of L-31W for the purpose of encouraging sheet flow to the eastern marl prairies, the average annual hydroperiod distribution for Taylor Slough and the eastern marl prairies is similar to Alternative 1. Alternative 1 and Alternative 2-Phase 1 both produce a similar increase in hydroperiod duration in the eastern Rocky Glades, relative to 95BaseMod conditions. Alternative 3-Phase

1 (IOP 2B) would increase the annual hydroperiod distribution for cells in the northeastern Rocky Glades, relative to Alternative 1 and Alternative 2-Phase 1. Phase 2 (IOP 2) of Alternatives 2 and 3 and Alternative 4 would produce hydroperiod increases similar to Alternative 3-Phase 1 in the northeastern Rocky Glades, but would also increase hydroperiods closer to the central, eastern Rocky Glades. None of the alternatives produce measurable changes in the central and lower portions of Taylor Slough. The effects of the alternatives on ponding depths follow a similar pattern to the hydroperiod distribution effects. Increases in hydroperiods in the eastern Rocky Glades areas adjacent to the LEC urban areas should benefit vegetative communities that have suffered from over drainage in the past. Marl prairies in the northern Rocky Glades adjacent to the LEC urban areas have been negatively affected by over drainage that resulted in invasion by woody shrubs and increases in fire frequency.

Alternatives 5 and 6 would impact vegetation in the eastern marl prairie and Taylor Slough similar to the other alternatives, but higher flows from S-332B should increase the beneficial hydrologic impacts to the region. However, increased phosphorus levels with overflows associated with Alternative 5 could have an adverse effect on the vegetative community. These impacts would be much lower with Alternative 6 due to the water quality attenuation with the additional 240 acre seepage reservoir.

Alternative 7 and Alternative 7R would impact vegetation in the eastern marl prairie and Taylor Slough similar to the No Action alternative, but higher flows from S-332B should increase the beneficial hydrologic impacts to the region.

Florida Bay

Wet season flows dominate the average annual freshwater flow volumes for all of the alternatives and 95BaseMod conditions. There are no substantial differences between the alternatives in average annual or monthly freshwater flow volumes towards Florida Bay, and none of the alternatives would substantially increase or decrease freshwater flows towards Florida Bay relative to 95BaseMod conditions. Consequently, none of the alternatives are expected to produce substantial changes in the Florida Bay salinity regime or significant impacts to mangrove or seagrass communities.

4.8 Fish and Wildlife

All of the alternatives increase hydroperiod duration and ponding depths in NESRS and are expected to benefit aquatic organisms. Populations of marsh fishes are expected to increase with increased hydroperiod duration and an increase in available habitat. Longer maintenance of dry season refugia is expected to increase survival over the dry season. Wading bird populations are expected to benefit from enhancement and expansion of foraging habitat and increases in the aquatic prey base. Increased hydroperiods and the associated reduction in fire frequency are expected to benefit tree island nesting habitat. Similarly, alligators are expected to benefit from the expansion and enhancement of habitat and increases in the prey base. Increases in hydroperiods are also expected to increase alligator abundance, nesting efforts, and nesting success.

Currently, the Rocky Glades/Eastern Marl Prairies are among the most degraded aquatic habitat within the southern Everglades (USACE 1999a). All of the alternatives would provide some benefit for the northern Rocky Glades and northern Taylor Slough by increasing hydroperiod duration and ponding depths. None of the alternatives would produce measurable changes in the central and lower portions of Taylor Slough. In general, increases in hydroperiod duration and ponding depths are expected to benefit fish and wildlife habitat by restoring more natural hydroperiods and reducing woody plant invasion and fire frequency in the northern Rocky Glades. Expansion of aquatic habitat and longer maintenance of dry season solution hole refugia are expected to increase the aquatic prey base and improve foraging habitat for wading birds. Increases in hydroperiods are also expected to increase alligator abundance, nesting efforts, and nesting success.

The occurrence of wading bird nests increased during ISOP implementation in 2000 to 39,480, an increase of 40 percent over the previous year (FWS 2001). Increase nesting in WCA 3, ENP, and Florida Bay were primarily responsible, although there was a substantial decrease of nesting in WCA 1.

In comparison to 1995 Base conditions, all of the alternatives would produce substantial increases in the frequency and depth of high water events in WCA 2A. Alternative 7R would provide benefit to the northern Rocky Glades and northern Taylor Slough (similar to the other alternatives) without substantially adversely affecting habitats located in WCA 2A or WCA 3B because of the continuous pumping of S-12D.

4.9 Protected Species

In accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 1531 *et seq*.) and Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.), the Department of the Interior has prepared a Planning Aid Letter and a Coordination Act Report for the IOP alternatives. A separate Coordination Act Report was prepared by the Florida Fish and Wildlife Conservation Commission under the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 1531 *et seq*.).

On April 2, 2002, the Corps received a Final Amended Biological Opinion on the Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow from the FWS. It should be noted that only the recommended alternative, Alternative 7R, was addressed by the FWS in the document. In the amendment, the FWS concurs that the recommended plan, Alternative 7R, is not likely to adversely affect the CSSS, wood stork, or eastern indigo snake; and that it would not introduce any additional effects to these species that were not previously considered in the February 19, 1999 B.O.

CSSS

Reasonable and Prudent Alternatives

The FWS B.O. presents the FWS RPA to the Experimental Program that would avoid jeopardizing the CSSS. The FWS RPA recommends that the selected IOP produce the following hydrological conditions for protection of the CSSS: 1) A minimum of 60 consecutive days of water levels at or below 6.0 feet NGVD at NP 205 between March 1 and July 15; 2) Ensure that 30%, 45%, and 60% of required regulatory releases crossing the Tamiami Trail enter ENP east of L-67 extension in 2000, 2001, and 2002; respectively (or produce hydroperiods and water levels in the vicinity of CSSS subpopulations C, E, and F that meet or exceed those produced by the 30%, 45%, and 60% targets); and 3) Produce hydroperiods and water levels in the vicinity of CSSS subpopulations C, E, and F that equal or exceed conditions that would be produced by Test 7, Phase 2 operations. ISOP 2000, ISOP 2001, and Alternative 7 meet or exceed 60 consecutive days of water levels at or below 6.0 feet NGVD at NP 205 in 25 of the 31 years (81% of the years) comprising the simulation period, (Alternative 4, described in the February 2001 DEIS, is the only alternative which meets the recommendation 84%, or in 26 of the 31 years). All of the alternatives meet or exceed the 30%, 45%, and 60% targets and meet or exceed conditions that would be produced by Test 7, Phase 2 operations.

Subpopulation A - Cape Sable Seaside Sparrow

All of the project alternatives produce approximately the same number of consecutive days of water levels at or below 6.0 feet NGVD at NP 205 between March 1 and July 15. As stated above, all alternatives meet or exceed this target in 25 of the 31 years comprising the simulation period. In comparison, 95BaseMod conditions meet or exceed this target in 23 of the 31 years that were simulated. Each of the alternatives would result in a similar reduction of annual flooding duration in the CSSS subpopulation A western marl prairie habitat relative to 95BaseMod conditions. The alternatives should have a similar beneficial effect on the western sparrow habitat by producing shorter hydroperiods that would benefit short hydroperiod marl prairie vegetation in the vicinity of CSSS subpopulation A.

Subpopulation B - Cape Sable Seaside Sparrow

None of the alternatives produce changes in the average hydroperiods or ponding depths in the vicinity of CSSS subpopulation B compared to 1995 Base conditions. Consequently, none of the alternatives is expected to alter the status of CSSS subpopulation B.

Subpopulations C, E, and F - Cape Sable Seaside Sparrow

All of the alternatives meet or exceed the FWS RPA recommendation for production of the 30%, 45%, and 60% regulatory release conditions. All of the alternatives would produce larger increases in annual average ponding depths and hydroperiod duration in the vicinity of CSSS subpopulation E compared to 95BaseMod conditions. The alternatives are expected to

provide the greatest beneficial effects for the eastern marl prairies by restoring longer, more natural hydrologic regimes to the area.

All of the alternatives meet or exceed the FWS RPA recommendation for implementation of Test 7, Phase 2 conditions in the vicinity of CSSS subpopulations C, E, and F; and all of the alternatives provide some benefit for CSSS subpopulations C, E, and F by increasing hydroperiods in the Rocky Glades. None of the alternatives produce measurable changes in the central and lower portions of Taylor Slough.

Subpopulation D - Cape Sable Seaside Sparrow

None of the alternatives produce changes in the average hydroperiods or ponding depths in the vicinity of CSSS subpopulation D compared to 1995 Base conditions. Consequently, none of the alternatives is expected to alter the status of CSSS subpopulation D.

Conclusion

Based on the best currently available scientific information, the FWS has determined that Alternative 7R represents an additional RPA for water-management actions to avoid jeopardy to the Cape Sable seaside sparrow and would not destroy or adversely modify designated critical habitat. Specifically Alternative 7R must be implemented in combination with all other RPA components contained in the February 19, 1999 B.O. with the exception of component #6, requiring the completion and operation of MWD by 2003. Since Alternative 7R only addresses the water management needs of the sparrow, all other RPA requirements contained in the February 19, 1999 B.O. will continue to apply.

Snail Kite

Restoration of longer, more natural hydroperiods in Shark River Slough and peripheral wetlands is expected to improve snail kite habitat in the ENP by creating more favorable conditions for apple snails. Average annual flooding duration and ponding depths in WCA 2 are not significantly different for Alternatives 5 and 6; however, Alternatives 2, 3, and 4 produce substantial increases in the frequency and depth of high water events in WCA 2A compared to 95BaseMod conditions. Increases in flooding may result in the loss of some small trees and the conversion of some long hydroperiod marshes to unvegetated open water habitat. Consequently, Alternatives 2, 3, and 4 may have a negative impact on snail kite foraging and nesting habitat in WCA 2A. Average annual flooding duration and ponding depths in WCA 2 with ISOP 2000, ISOP 2001, and Alternative 7 and 7R are greatly improved when compared to 95BaseMod. Average annual flooding duration and ponding depths in WCA 3A are not significantly different for the alternatives. Consequently, none of the alternatives is expected to significantly alter the status of snail kites or their habitat in WCA 3A.

In the February 19, 1999 BO, the FWS concluded that the snail kite would be adversely affected by the C&SF Project operations, at that time known as Test 7, Phase I, of the Experimental Program of Water Deliveries to Everglades National Park. No incidental take of snail kites was anticipated; however, the incidental take analysis was developed based on the premise that the original RPA would be implemented. The original RPA would have

eliminated detrimentally deep water levels and long hydroperiods in southern and eastern WCA 3A, as water was shifted from WCA 3A in order to meet the RPA targets for water releases east of the L-67 Extension. The recommended alternative, Alternative 7R, was proposed as the biological equivalent for providing the same protection to the Cape Sable seaside sparrow as would the water management provisions of the original RPA. Alternative 7R would not provide the same relief in terms of hydrologic improvements to the southern and eastern portions of WCA 3A as would the original RPA.

The Corps agreed to implement a "Construction Monitoring Plan" for C-111 and MWD features operating with Alternative 7R for snail kites that would avoid disturbance to nesting snail kites, and construction activities will only occur within, or nearly within, existing structure footprints. Thus, according to the FWS, activities associated with C-111 and MWD features operations are not likely to adversely affect the snail kite. The FWS concurs, however, that operational implementation of Alternative7R could adversely affect snail kites and designated snail kite critical habitat in WCA 3A but would not likely jeopardize the species.

As stated in the Final Amended B.O., the FWS anticipates that Alternative 7R would result in incidental take in the form of "harm" resulting from significant habitat modification or degradation that results in death or injury to individual snail kites by impairing essential breeding and foraging patterns measured by the frequency and duration of high-water events. The two indicator regions where snail kites have been documented and for which SFWMM results predict are the most problematic in terms of experiencing excessively high water levels are Indicator Regions 14 and 19. Thus, if actual operations of Alternative 7R produce higher water levels than those predicted to occur via the SFWMM in Indicator Regions 14 (Southern WCA 3A) and 19 (Eastern WCA 3A), as measured by a gauge or gauges mutually agreed upon by the FWS and the Corps as compared to a five-year rolling average of the model output for those indicator regions, then the Corps would have exceeded the incidental take authorized by this amendment. This incidental take is anticipated to occur annually until implementation of CSOP. The CSOP is scheduled for full structural and operational implementation no later than 2007. This level of incidental take is to be considered an addition to the incidental take authorized by the February 19, 1999 BO, as amended. Full details regarding the terms and conditions for the incidental take are included in the Final Amended B.O. (Appendix B).

Wood Stork

The quality of foraging habitat in NESRS and the Rocky Glades is expected to improve as a result of increases in annual hydroperiod distribution with all Alternatives. Longer hydroperiods are expected to improve foraging habitat by expanding the available habitat for aquatic prey base species and prolonging the availability of dry season refugia for prey species. All of the alternatives are expected to provide the benefit for NESRS and Rocky Glades habitats by providing increases in ponding depths and hydroperiod distributions. None of the alternatives are expected to improve the reduced freshwater flows to the traditional mangrove nesting and foraging habitats of Florida Bay. Consequently, all alternatives may continue conditions that are likely to delay colony formation and decrease the probability of a successful nesting season in Florida Bay.

According to the FWS in the Final Amended B.O., Alternative 7R is not likely to produce water levels as low as the original RPA for wood stork habitat in southern and eastern WCA 3A; however, wood storks have been documented as successfully nesting and raising young under conditions that have been produced under the current ISOP. Based on the best currently available scientific information, the FWS concluded that Alternative 7R is consistent with implementation of the water management provisions of the existing RPA.

The FWS anticipates that Alternative 7R is not likely to cause additional effects to the wood stork beyond those analyzed in its February 19, 1999 BO. Accordingly, the February 19, 1999 B.O. and incidental take statement will continue to provide the FWS' recommendations for compliance with the Endangered Species Act, and the wood stork will not be considered further.

Florida Panther

The Florida panther occurs primarily in upland habitats. Hydrologic effects of the alternatives are expected to be limited to existing or historic wetlands and are not expected to have significant effects on the upland habitats preferred by these species. However, a component of Alternatives 6, 7, and 7R involves construction of a 240-acre seepage reservoir consisting of former agricultural lands lying immediately northeast of the existing West Water Detention Area (Figure 4). The site extends north from the vicinity of the S-332B discharge pipes to Hamlin Mill Road, and the eastern and southern boundaries are fenced with 3-strand barbed wire fencing. The land is largely in the early stages of old field succession with a margin of tall, dense grasses and woody shrubs. Other than old truck-farm fields, the area includes two mango groves. An approximately 26-acre fenced grove in the east central portion of the area is relatively well manicured, with no ground or shrub layer and orderly rows of mature mango trees forming a closed canopy. An approximately 60-acre site in the northwest corner consists of smaller mango trees, more open canopy, and an overgrown, weedy shrub layer.

Fresh panther tracks were identified in November 2000 along a farm dirt roadway in the northeast corner of the proposed site. The panther database revealed two records of panther located in the project area: both were of panther #16, which was originally collared in 1986, and died in early 2000. The habitats of possible panther utilization are the two mango grove areas, which could serve primarily as movement corridors. The area in question is on the fringe of the panther habitat, and construction of the seepage reservoir would not likely significantly affect the panthers (S. Bass, personal communication with J. Moulding). However, any loss of panther habitat should be carefully considered and would be considered significant.

The FWS concurs in the amended B.O. that although some loss of panther habitat would occur with construction of the reservoir, panther habitat in adjacent areas within the ENP should realize an overall ecological improvement. The FWS determined that implementation of Alternative 7R is not likely to adversely affect the Florida panther.

Eastern Indigo Snake

The eastern indigo snake occurs primarily in upland habitats. Hydrologic effects of the alternatives are expected to be limited to existing or historic wetlands and are not expected to have significant effects on the upland habitats preferred by this species. Consequently, no adverse effects to the eastern indigo snake are expected as a result of any of the alternatives. The FWS concurred that the recommended alternative, Alternative 7R, is not likely to adversely affect the eastern indigo snake.

4.10 Air Quality

There would be no significant impact to air quality under any alternative.

4.11 Noise

There would be no significant impact to noise levels under any of the project alternatives. The ambient noise levels with the current operations would experience only slight changes with implementation of any of the alternatives.

4.12 Aesthetics

There would be no significant impact to aesthetics with any of the project alternatives. Construction of new facilities would occur only under Alternatives 6, 7 and 7R, and this would occur in an area that consists of former agricultural fields and mango groves. No alteration of the aesthetic characteristics of the region would occur with any of the other alternatives.

4.13 Recreation

There would be no significant impact to recreation with any of the project alternatives. Current recreational activities would not be disrupted due to any of the alternatives.

4.14 Land Use

There would be no significant impact to land use with any of the project alternatives. There are currently a number of parcels of privately owned, undeveloped land located within the ENP Expansion Area, which could experience higher water levels with the No Action Alternative as well as with all of the project alternatives, but acquisition of these parcels is being actively pursued by the National Park Service and should be complete in the near future. Agricultural landowners located east of ENP and L-31 indicated concerns, in public comments on Alt 7 as proposed in the SDEIS, that implementation of Alt 7 would be likely to increase the probability of water-table rise or flooding of farmlands located near the canal when canal stages were high, and therefore might adversely affect use of some of these lands

for farming. In response to this concern additional detention and pumping capability were added to this Alternative by construction of authorized features of the C-111 and MWD projects, including above-ground reservoirs and interim pumps, providing additional flood reduction capability in the system.

4.15 Socioeconomics

There would be no adverse socioeconomic impact under any of the project alternatives.

4.16 Agriculture

To analyze agricultural conditions in the areas designated as LEC, which is the area to the east of the L-31N, L-31W, C-111 canal complex, a number of cells were identified and data produced from the 31-year simulation runs for different operational scenarios. These cells are located in a north/south alignment just to the east of the canal complex.

From an agricultural viewpoint, the most important parameter is root zone, which is normally measured from ground surface to a depth of two feet. Thus the most revealing data from the simulation runs is percent of time the water surface is within the root zone. There are concerns from an agricultural view that high water levels in the eastern canals (L-31N, L-31W, and C-111) would induce water levels in the agricultural areas that would encroach on the two-foot root zone criteria and thus damage crops. Analysis of the 31-year simulation runs for specific monitoring cells along a north-south line in the lower east coast area identified one cell where the percent of time water levels would encroach on the two-foot root zone was near 50%, but the percent of time the water level reached or exceeded ground surface was less than 10%. The remaining eight cells experienced water levels at or below the root zone 70%to 100% of the time for Alternative 7. Hydrologic modeling has not been conducted for Alternative 7R. However, operating parameters for this alternative are similar to those of Alternative 7, and additional flood storage capacity would be available with the C-111 and MWD components to provide more flexibility to mitigate flooding east of the L-31N canal.

4.17 Hazardous, Toxic, and Radiological Materials

None of the alternatives is believed likely to impact HTRW sites.

4.18 Cultural Resources

There would be no significant impacts to cultural resources from implementation of any of the alternatives. Current water level and inundation patterns would not be significantly altered with any of the alternatives that could affect known or unknown prehistoric or historic sites on tree islands or in solution holes.

4.19 Cumulative Impacts

The project area has been subject to federal involvement for many years. The need for flood control, water supply, recreation, and fish and wildlife enhancement has provided a difficult task of balancing various, and sometimes-conflicting needs for the region. In the early years of the C&SF Project, flood control was the overriding goal, and eventually the need for additional water supplies for south Florida required additional modification to the project. The Everglades National Park Protection and Expansion Act of 1989 directed the Corps:

"to construct modifications to the Central and South Florida Project to improve water deliveries into the park and shall, to the extent practicable, take steps to restore the natural hydrological conditions within the park."

Since that time, a number of federal actions have been authorized and implemented that have attempted to improve the flow of water to the ENP without compromising the other needs of the region (i.e., flood control, water supply). The cumulative effects of these actions have been mostly positive. However, some adverse effects have occurred. The 1999 Restudy Plan (USACE 1999a) has already addressed cumulative effects of lost agricultural land use with the expansion of publicly owned lands in the region.

Cumulative impacts to the ENP in terms of hydrology, water quality, and natural resources has occurred with the many federal projects implemented over the years. However, this proposed action, along with other recent and future projects, should not hinder progress to eventually restore the hydrology of the ENP to more natural conditions.

4.20 Incomplete or Unavailable Information

The analysis provided in Section 4.0, Environmental Consequences, of this document are based on current knowledge of physical and biological conditions in the project area, and on projections of most probable future conditions as indicated by hydrologic models. It is recognized that new technical information may be developed as the selected plan is implemented and that observed results may differ from predicted results. Considering this, it may be necessary to adjust operations to address the new information or observed results to achieve better performance for environmental restoration and protection to ensure the health, safety, and well being of the general public and affected individuals.

4.21 Unavoidable Adverse Impacts

Unavoidable adverse impacts could occur with all alternatives. Under extraordinary and uncommon conditions, impacts to water quality below pump station S-332B might occur with predicted overflow under all alternatives, but overflows would be eliminated upon completion of the S-332B north seepage reservoir and partial S-332B/S-332B connector under Alternative 7R. The detention of excess water in the WCAs could also occur with the alternatives, and would likely continue in the future without full implementation of the MWD project. The

impacts of this detention could include loss of tree island vegetation and associated wildlife, adverse impacts to snail kite nesting and critical habitat, and adverse impacts to wood storks.

4.22 The Relationship Between Local Short-Term Uses of Man's Environment and Maintenance of Long-Term Productivity

The proposed project was developed in response to the February 1999 FWS Biological Opinion for the MWD project, Experimental Program, and C-111 Project. The proposed IOP is designed to avoid jeopardizing the CSSS, a federally endangered species occurring within the ENP, during the interim period leading up to completion of the MWD project. The short-term uses of the environment with this project are greatly justified by the potential long-term benefit to this species.

4.23 Irreversible and Irretrievable Commitments of Resources

The proposed project would be in effect only until the full MWD Project is completed. The commitment of resources would be temporary in nature with this project, and the irreversible and irretrievable commitment of resources would be minimal. Loss of marginal Florida panther habitat would occur with implementation of Alternative 7R due to construction of the S-332B seepage reservoir.

4.24 Energy Requirements and Conservation Potential

Energy use of the recommended plan would be minimal and energy requirements for implementing any of the project alternatives would be similar. Conservation potential for any of the alternatives would be minimal.

4.25 Environmental Commitments

The Corps will continue to operate the water control structures as authorized and approved. The Corps will continue to consult with the FWS, ENP, SFWMD, FFWCC, and other federal, state, local, tribal, and private interests to improve and modify the operations as circumstances dictate. The Corps will incorporate any commitments required by the appropriate regulatory agencies identified during the NEPA and ESA processes. The Corps will re-evaluate the operational parameters of the selected alternative as information becomes available and will coordinate with the interested parties previously mentioned with any modifications.

5.0 COMPLIANCE WITH FEDERAL STATUTES, EXECUTIVE ORDERS, AND POLICIES

5.1 Archeological and Historic Preservation Act and National Historic Preservation Act.

Archival research and consultation with the State Historic Preservation Officer (SHPO) have been initiated in accordance with the National Historic Preservation Act, as amended; the Archeological and Historic Preservation Act, as amended and Executive Order 11593. SHPO consultation was initiated August 22, 2001. In September, 2001, the SHPO indicated its concurrence with the USACE determination of no effect for Alternative 7, the preliminary recommended plan. Consultation has been re-initiated for Alternative 7R. The USACE has again made a determination of no effect, based on prior coordination of the additional elements of this Alternative (interim pump stations and reservoirs) under the MWD and C-111 NEPA processes. The additional lands are moreover former agricultural lands that have been deeply rock-plowed. At this time USACE expects full SHPO concurrence. The project would not affect historic properties included in or eligible for inclusion in the National Register of Historic Places. At this time coordination has not been completed. The project is in partial compliance with each of these Federal laws. The project and USACE determination of no effect has also recently been coordinated with the Miami-Dade County Historic Preservation Officer.

5.2 Clean Air Act.

The affected air-shed is not a non-compliance area. No air quality permits would be required. This Final EIS will be coordinated with concerned agencies, including the U.S. Environmental Protection Agency (EPA), other stakeholder agencies and the public, and would then be in full compliance with Section 309 of the Act.

5.3 Clean Water Act.

Actions under the recommended IOP plan, as well as the ISOP operations discussed in this Final EIS, did not and would not result in the release of contaminants into the aquatic environment. The ISOP plans have been coordinated with the Florida Department of Environmental Protection (DEP), and the structures are operating under an emergency exemption as discussed in the Water Quality section. A permit application is pending for the recommended alternative operations, subject to completion of this NEPA process. ISOP 2000, 2001, and proposed IOP operations are fully compliant with this law. This law also regulates wetlands protection. The net result of proposed operations under the recommended alternative is an improvement in hydropatterns in NESRS due to improved water deliveries and partially degrading L-67 Extension Levee, while excessively high water stages near the western populations would continue to be avoided. A 404(b)1 evaluation of wetlands impacts due to filling in the L-67 Extension Canal was included in the 1992 EIS on Modified Water Deliveries to Everglades National Park (Mod Waters, USACE 1992). Construction of the S-332 seepage reservoirs was included in the May 1994 EIS on the C-111 General Reevaluation

Report (USACE 1994) and the January 2002 Environmental Assessment on the C-111 GRR Supplement (USACE 2002). Therefore, no 404(b)1 analysis is required for this action.

5.4 Endangered Species Act.

On April 2, 2002, the Corps received an amendment to the February 19, 1999 Biological Opinion which states that IOP Alternative 7R is not likely to adversely affect the CSSS, wood stork, or eastern indigo snake, and that it would not introduce any additional effects to these species that were not previously considered in the 1999 B.O (Appendix B). Although there would be some loss of Florida panther habitat due to construction of the S-332B seepage reservoir, the ENP would realize an overall ecological improvement. Therefore, the FWS determined that IOP Alternative 7R is not likely to adversely affect the Florida panther.

The FWS states that although Alternative 7R would adversely affect the snail kite and designated snail kite habitat, it is not likely to jeopardize the continued existence of the species or result in the destruction or adverse modification of the designated critical habitat. The terms and conditions of the incidental take are included in the Final Amended BO.

5.5 Federal Water Project Recreation Act; Land and Water Conservation Fund Act.

No public recreational facilities would be impacted under any alternative considered in this document. Both ISOP and IOP operations are specified as complying with this law.

5.6 Fish and Wildlife Coordination Act.

Reports were prepared by the Department of the Interior (U.S. Fish and Wildlife Service, National Park Service, Everglades National Park) and the Florida Fish and Wildlife Conservation Commission (FFWCC) in compliance with this law. The DOI Coordination Act Report (CAR) and its Addendum, provided to the Corps on August 2, 2001, are included in this Final EIS as Appendix C. The CAR discusses ISOP operations as well as the alternatives proposed in the Final EIS for the IOP. The CAR provides analyses that support the opinion of these Department of the Interior agencies that ISOP operations may not have fully met 2000 and 2001 RPA targets, and that overflow of the S-332B weir under ISOP and some IOP alternatives may have led or lead to introduction of unacceptably high levels of nutrients into the Park, or lead to changes in dominant vegetation. A Supplement to the CAR was provided on September 28, 2001. This Supplement, which discusses the previous preferred alternative (Alternative 7), is reproduced in the same appendix as the CAR. Additionally, the Corps has provided a different analysis of these issues in the text of this SDEIS, based on its understanding of water quality sampling and analysis, and of model limitations and results. Further considerations are provided as a second appendix following on the FWS CAR and Supplement to the CAR. In addition to stating that Alternative 7 would "likely meet ESA requirements for the CSSS," the Addendum further states that the recommended alternative "should maintain or improve habitat suitability as compared to the ISOP or Draft IOP EIS alternatives."

5.7 Farmland Protection Policy Act.

This FEIS addresses operational changes of an existing system of levees, canals and structures. Only the new detention area has the potential to affect farmland. The lands recommended for construction of the additional detention areas at S-332B, S-332C and S-332D were previously classified as Statewide Unique farmlands (rock-plowed lands with a 12-month growing season). However, they were acquired by the South Florida Water Management District as authorized under the C-111 Project (USACE, 1994), and are part of the "C-111 buffer area." While the SFWMD continues to lease some of this land for farming, its ultimate fate (removal from agricultural use) has already been determined. No further adverse effects to farmlands would occur as a result of building additional detention areas now as recommended in Alternative 7R of this operational plan. Therefore, re-coordination with the Natural Resources Conservation Service is not necessary. The recommended alternative is in compliance.

5.8 National Environmental Policy Act.

A Draft EIS (DEIS) for the Interim Operational Plan was coordinated with the public and agencies beginning on February 23, 2001, and a SDEIS circulated for a period of 45 days, beginning with the publication of the Notice of Availability in the Federal Register and ending on November 26, 2001. This Final EIS was prepared and coordinated in full compliance with NEPA, and the Plan will be in full compliance with NEPA after completion of the final comment period, when a Record of Decision is signed.

5.9 Coastal Zone Management Act.

The FEIS will be coordinated with the Florida Department of Community Affairs, the State clearinghouse for Coastal Zone Management Plan consistency review. The State of Florida undertakes consistency review of both Draft and Final Environmental Impact Statements. Previous coordination of the DEIS and SDEIS led to a determination by the Clearinghouse that the plan was consistent at that time.

5.10 Resource Conservation and Recovery Act and Toxic Substances Management Act.

No items regulated under these laws or other laws related to hazardous, toxic or radioactive waste substances have been discovered. None are considered likely to exist in the project area, including the proposed seepage reservoirs.

5.11 E.O. 11988. Floodplain Management.

This Order directs Federal agencies to avoid siting projects in floodplains and to avoid inducing further development of flood-prone areas. All considered alternatives, including the no-action alternatives and recommended alternatives in the ISOP and the IOP, are in

compliance with this Executive Order. The proposed operational changes continue to reduce hazards and risks associated with floods, minimize the impact of floods on human safety, health and welfare, and restore and preserve the natural and beneficial uses of the base flood plain.

5.12 E.O. 11990. Protection of Wetlands.

This Order directs Federal agencies to avoid developing or siting projects in wetlands. The recommended alternative is in full compliance. Recommended alternative operations would reduce seepage of ground water away from wetlands along the Eastern Everglades boundary and partially re-hydrate wetlands in CSSS populations E and F during the rainy season, while providing for adequate water level controls for western CSSS populations during the nesting season. Additionally, the southernmost 4 miles of the L-67 levee extension would be degraded, returning the levee footprint to wetlands.

5.13 E.O. 12898. Environmental Justice.

This Order directs Federal agencies to provide for full participation of minorities and low-income populations in the Federal decision-making process, and further directs agencies to fully disclose any adverse effects of plans and proposals on minority and low income populations. The ISOPs and proposed IOP are in full compliance. The operations of the structures discussed herein, in addition to providing acceptable protection to populations of the CSSS, would benefit all population groups of southern Miami-Dade County by providing flood reduction, drinking water supply protection, and restoration of the wetlands and other natural resources inside and outside Everglades National Park.

6.0 PUBLIC INVOLVEMENT

The various agencies, affected stakeholders, and interested members of the community were allowed opportunities to provide input during the NEPA process. A number of public and plan development workshops were held to elicit input from interested parties. Table 6.1 provides a list of announcements, interagency coordination, and public workshops conducted throughout this process. A summary of the scoping process was included in Section 1.5.

Table 6.1 Public Involvement Summary

Action	Location	Date
NOI published in Federal Register	NA	13 August 1999 (Volume 64, Number 156)
Scoping Letter Mailed	NA	26 October 1999
Scoping Meeting	Homestead, FL	16 November 1999
1st Round of Modeling Posted on the Corps Website	NA	24 March 2000
Interagency Meeting	Ft. Lauderdale, FL	10 April 2000
Public Workshop	Homestead, FL	25 April 2000
2nd Round of Modeling Posted on the Corps Website	NA	28 April 2000
Interagency Meeting	Ft. Lauderdale, FL	15 May 2000
3rd Round of Modeling Posted on the Corps Website	NA	31 May 2000
Public Workshop	Homestead, FL	7 June 2000
Public Workshop	Homestead, FL	30 January 2001
Public Workshop	Homestead, FL	20 June 2001
Presentation to the Governing Board of the SFWMD	West Palm Beach, FL	12 July 2001
Public Workshop	Miami, FL	16 July 2001
Stakeholder Outreach	Homestead, FL	20 July 2001
Stakeholder Outreach	Jacksonville, FL	13 August 2001
Stakeholder Outreach	Ft. Lauderdale, FL	22 August 2001
Public Workshop	Homestead, FL	29 October 2001

7.0 DISTRIBUTION

A list of agencies, organizations, and private individuals that will be sent a copy of the Final EIS is attached.

8.0 LIST OF PREPARERS

Table 8.1 List of Preparers

Name	Affiliation	Role
Dr. Jon Moulding, PhD.	USACE	Document Management and Review
Ms. Barbara Cintron	USACE	Document Review
Mr. Elmar Kurzbach	USACE	Document Review
Dr. Richard Punnett, PhD.	USACE	Hydrologic Modeling
Mr. Lan Do	USACE	Hydrologic Modeling
Ms. Susan Sylvester, PE	USACE	Hydrologic Review
Mr. James Riley	USACE	Water Quality Review
Mr. Mark Shafer	USACE	Water Quality Review
Ms. Cheryl Ulrich, PE	USACE	Project Manager, Document Review
Mr. Tracy Hendron	USACE	Hydrologic Review
Mr. Don Nelson	USACE	Document Review
Mr. John Brady	USACE	Document Review
Mr. Lee Swain	Dial Cordy and Associates	Impact Analysis, Document Preparation
Mr. Rahlff Ingle	Dial Cordy and Associates	Natural Resources Impact Analysis, Report Preparation
Mr. James Tuttle, P.E.	Gulf Engineers & Consultants	Hydrologic Analysis
Ms. Markay Brown	Gulf Engineers & Consultants	Hydrologic Review

9.0 CONCLUSIONS

The consensus Recommended Alternative would meet or exceed the 30%, 45%, and 60% targets and meet or exceed conditions that would be produced by Test 7, Phase II operations. The recommendations provided by the FWS' Final Coordination Act Report (CAR) (FWS 2001) were incorporated into the recommended alternative design. S-334 would be the primary route for WCA 3A regulatory flows, the S-332B retention area would be constructed and overflow would only be allowed under limited circumstances described in the Pre-storm/Storm/Storm Recovery Operations. A trigger was included to prevent further S-332B operations if the adjacent CSSS habitat experiences hydroperiods greater than 180 days, and lower canal stages and increased pumping would only be implemented when WCA 3A regulatory releases are through the SDCS except under circumstances described in the Pre-storm/Storm/Storm Recovery Operations. In addition, improved SFWMM and MODBRANCH hydrologic models would be used for future modeling efforts, and the Corps would use a more collaborative approach to reach consensus with other agencies on future projects. On this basis, the FWS concurs that Alternative 7R, the recommended alternative, is acceptable.

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11.0 INDEX

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